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Pseudomonas fluorescens Strain A506

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Overview

Registration Decision for *Pseudomonas fluorescens* Strain A506

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* (PCPA) and Regulations, has granted conditional registrations for the sale and use of *Pseudomonas fluorescens* Strain A506 and Blightban A506, containing the technical grade active ingredient *Pseudomonas fluorescens* strain A506, to control fire blight on apples and pears.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risks and value have been found acceptable when all risk reduction measures are followed, the applicant must submit additional scientific information as a condition of registration.

This Overview describes the key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessments of *Pseudomonas fluorescens* Strain A506 and Blightban A506.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the PCPA is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[1] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its proposed conditions of registration. The Act also requires that products have value[2] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

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1 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

2 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's *(a)* efficacy; *(b)* effect on host organisms in connection with which it is intended to be used; and *(c)* health, safety and environmental benefits and social and economic impact."

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in humans (e.g. children) as well as organisms in the environment (e.g. those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the PMRA's website at healthcanada.gc.ca/pmra.

What Is *Pseudomonas fluorescens* Strain A506?

Pseudomonas fluorescens strain A506 is a naturally occurring strain of bacterium that is used as a microbial pest control agent (MPCA) for the suppression of *Erwinia amylovora*, the pathogen that causes fire blight on apple and pear trees. Blightban A506 is a commercial end-use product containing *Pseudomonas fluorescenss* strain A506 as the active ingredient. *Pseudomonas fluorescens* strain A506 works by competitively excluding the pathogen for space and nutrients on branches and leaves and on blossom.

Health Considerations

Can Approved Uses of *Pseudomonas fluorescens* Strain A506 Affect Human Health?

***Pseudomonas fluorescens* strain A506 is unlikely to affect your health when used according to the label directions.**

People could be exposed to *Pseudomonas fluorescens* strain A506 when handling and applying Blightban A506. The PMRA considers several key factors when assessing health risks: the microorganism's biological properties (e.g., production of toxic by-products), reports of any adverse incidents, its potential for pathogenicity, infectivity and toxicity as determined in toxicological studies as well as the likely levels to which people may be exposed to this strain relative to exposures already encountered in nature to other strains of this microorganism.

Toxicological studies in laboratory animals describe potential health effects from large doses to identify any potential pathogenicity, infectivity and toxicity concerns. *Pseudomonas fluorescens* strain AGS 3001.2, a strain similar to *Pseudomonas fluorescens* strain A506, was found to be mildly irritating to the skin; therefore the precautionary words "CAUTION: Skin irritant " are required on the technical and end-use product labels.

No other significant toxicity or signs of disease were observed in the toxicity studies submitted to support *Pseudomonas fluorescens* strain A506.

To confirm the lack of infectivity potential of *Pseudomonas fluorescens* strain A506, the Agency is requiring a full toxicity and infectivity guideline study as a condition of registration.

Residues in Water and Food

Dietary risks from food and water are not of concern

The *Food and Drugs* Act prohibits the sale of food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for the *Food and Drugs Act* purposes through the evaluation of scientific data under the PCPA. Each MRL value determines the maximum concentration in parts per million (ppm) of a pesticide allowed in or on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Strains of *Pseudomonas fluorescens* are common in nature. While the use of Blightban A506 in orchards will lead to transient increases in populations over the long-term, it is not expected to significantly increase natural environmental background levels of this microorganism. Furthermore, no significant adverse effects were reported when a mixture containing *Pseudomonas fluorescens* strain A506 and other *Pseudomonas* strains, or when *Pseudomonas fluorescens* strain AGS 3001.2, a strain similar to *Pseudomonas fluorescens* strain A506, was administered orally to rats.

Also, given that Blightban A506 is applied to pome fruit trees at the flowering stage, *Pseudomonas fluorescens* strain A506 is not expected to come into direct contact with fruit, and consequently, the proposed food use pattern is unlikely to result in significant residues on fruit at the time of harvest. Consequently, dietary exposure and risks are minimal to non-existent, and the establishment of an MRL is not therefore required for *Pseudomonas fluorescens* strain A506.

Occupational Risks from Handling Blightban A506

Occupational risks are not of concern when Blightban A506 is used according to label directions, which include protective measures

Workers using Blightban A506 can come into direct contact with *Pseudomonas fluorescens* strain A506 on the skin, in the eyes, or by inhalation. For this reason, the label specifies that users exposed to Blightban A506 must wear waterproof gloves, long-sleeved shirts, long pants, an U.S. National Institute for Occupational Safety and Health (NIOSH) approved respirator (with any N–95, R–95, P–95 or HE filter), and shoes plus socks. Early-entry workers are restricted from entering areas where Blightban A506 has been applied for a period of 4 hours unless wearing the indicated personal protective equipments.

For bystanders, exposure is expected to be much less than that of handlers and is considered negligible. Therefore, health risks to bystanders are not of concern.

Environmental Considerations

What Happens When *Pseudomonas fluorescens* Strain A506 Is Introduced into the Environment?

Environmental risks are not of concern.

Based on the limited use pattern of Blightban A506 in apple and pear orchards, natural populations of *Pseudomonas fluorescens* strain A506 are not expected to considerably increase in the terrestrial environment, and indirect exposure to aquatic environments is expected to be minimal. Cases of infection or disease in animals associated with other strains of *Pseuodomonas fluorescens* are few, and none involved strain A506. Also, *Pseudomonas fluorescens* strain A506 is not expected to be pathogenic to plants.

Value Considerations

What Is the Value of Blightban A506?

Blightban A506 is a new biological pesticide that may be used with Streptomycin 17, a bactericide currently registered for fire blight control which has important resistance management issues. Blightban A506 is compatible with streptomycin and should be used in an integrated fire blight suppression program. Suppression of the fire blight pathogen, *Erwinia amylovora*, with Blightban A506 will help reduce grower reliance on streptomycin.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures specified on the label of Blightban A506 to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

Human Health

Because of concerns with users developing allergic reactions through repeated high exposures to *Pseudomonas fluorescens* strain A506, anyone handling or applying Blightban A506 must wear waterproof gloves, long-sleeved shirts, long pants, and shoes plus socks, as well as a NIOSH approved respirator (with any N–95, R–95, P–95 or HE filter).

Environment

As a general precaution, the label prohibits the use of Blightban A506 to control aquatic pests. The label also offers advice to reduce runoff into aquatic habitats and to minimize spray drift. Handlers are also directed not to contaminate surface water by improper disposal of equipment wash waters.

What Additional Scientific Information Is Being Requested?

Although the risks and value have been found acceptable when all risk-reduction measures are followed, the applicant must submit additional scientific information as a condition of registration. More details are presented in the Science Evaluation of this Evaluation Report or in the Section 12 Notice associated with these conditional registrations. The applicant must submit the following information within the time frame indicated.

Product Characterization and Analysis

To confirm that the protein electrotyping method satisfies the requirement for a strain-specific identification method for the MPCA, the registrant is required to provide an image of the gel. In the event that the protein electrotyping method does not fully satisfy the requirements, detailed methodology on the restriction fragment length polymorphism (RFLP) fingerprint method with pulsed field gel electrophoresis (PFGE) will be required.

Human Health

To confirm the lack of infectivity potential of *Pseudomonas fluorescens* strain A506, the registrant is required to provide a full toxicity and infectivity guideline study using either the pulmonary instillation or intravenous route of administration.

The applicant must submit this information no later than September 1, 2010.

Other Information

As these conditional registrations relate to a decision on which the public must be consulted,[3] the PMRA will publish a consultation document when there is a proposed decision on applications to convert the conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

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[3] As per subsection 28(1) of the *Pest Control Products Act*.

The test data cited in this Evaluation Report (i.e. the test data relevant in supporting the registration decision) will be made available for public inspection when the decision is made to convert the conditional registrations to full registrations or to renew the conditional registrations (following public consultation). If more information is required, please contact the PMRA's Pest Management Information Service by phone (1-800-267-6315) or by e-mail (pmra.infoserv@hc-sc.gc.ca).

Science Evaluation

Pseudomonas fluorescens Strain A506

1.0 The Active Substance, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active microorganism	*Pseudomonas fluorescens* strain A506
Function	Suppress the fire blight pathogen, *Erwinia amylovora,* in commercial apple and pear orchards
Binomial name	*Pseudomonas fluorescens* strain A506
Taxonomic designation	
Kingdom	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Pseudomonadales
Family	Pseudomonadaceae
Genus	*Pseudomonas*
Species	*fluorescens*
Strain	A506
Patent Status information	Canadian Patent No. CA1192154
Minimum purity of active	5.0×10^{10} CFU/g
Identity of relevant impurities of toxicological and/or environmental significance.	The TGAI does not contain any impurities or micro contaminants known to be the Toxic Substances Management Policy (TSMP) Track 1 substances.

1.2 Physical and Chemical Properties of the Active Ingredient and End-use Product

As Blightban A506 is manufactured following a continuous process, there is no true intermediate stand-alone technical active ingredient.

End Use Product—Blightban A506

Property	Result
Colour	White
Odour	Odourless
Physical state	Fine powder, freeze-dried
Formulation type	Live organism
Guarantee	1×10^{10} CFU/g
pH	6.7 (5% slurry)
Density	0.4 g/cm^3
Storage stability	1 week at 21°C, or 1 month at 4°C, or up to 9 months at -27°C
Corrosion characteristics	Non-corrosive
Explodability	Non-explosive

1.3 Directions for Use

BlightBan A506 is a powder formulation of *Pseudomonas fluorescens* strain A506 with a guarantee of 1 x 10^{10} CFU/g. It is intended to be used for suppression of fire blight (*Erwinia amylovora*) on apples and pears.

BlightBan A506 is applied at 370 g/ha in 1000 to 2000 L of water per hectare up to three times per season beginning at 15-20% bloom, then at first petal fall to full bloom, and finally at post petal fall or rattail bloom. BlightBan A506 should be used in an integrated fire blight control program and is compatible with streptomycin.

1.4 Mode of Action

Pseudomonas fluorescens A506 was originally isolated from pear in California. It is a natural antagonist of *Erwinia amylovora*, the bacterial pathogen that causes fire blight in apple and pear. The suppression of *Erwinia amylovora* by *Pseudomonas fluorescens* is achieved through competition for the same ecological niche, i.e. for nutrients and space on apple and pear flowers.

2.0 Methods of Analysis

2.1 Methods for Identification of the Microorganism

Pseudomonas fluorescens strain A506 is identified to the species level, in Biotype A, by biochemical characteristics, colony morphology, and molecular methods which use polymerase chain reactions (PCR) coupled with multiple enzyme restriction fragment length polymorphism (MERFLP) analysis and phylogenetic analyses of nucleotide sequences of *Pseudomonas*-specific genes.

A protein electrotyping method with immunofluorescent staining was found to be acceptable for strain-specific identification of *Pseudomonas fluorescens* strain A506. However, the scan of the gels was of poor quality. Therefore, an image of the gel with better resolution will be required to support the requirement of a strain-specific identification method for the MPCA. In the event that the protein electrotyping method does not prove satisfactory, detailed methodology on the RFLP fingerprint method with PFGE will be required for strain-specific identification of the MPCA.

2.2 Methods for Establishment of Purity of Seed Stock

A stock of *Pseudomonas fluorescens* strain A506 is maintained frozen in liquid nitrogen and is used to generate a primary mother culture. From the primary mother culture, a secondary mother culture is sub-cultured and used for inoculation of the fermentation mixture. A culture is also stored at the American Type Culture Collection (ATCC) as accension number ATCC 31948.

Practices for ensuring the purity of the seed stock were adequately described in the method of manufacture and quality assurance program.

2.3 Methods to Define the Content of the Microorganism in the Manufactured Material Used for the Production of Formulated Products

The potency (CFU/g) of *Pseudomonas fluorescens* strain A506 is determined by plate counts on standard media with antibiotics to which the MPCA is resistant.

2.4 Methods to Determine and Quantify Residues (Viable or Non-viable) of the Active Microorganism and Relevant Metabolites

Pseudomonas fluorescens is ubiquitous in nature, and has been isolated from a wide variety of environments. The use of Blightban A506 in orchards is not expected to significantly increase the natural environmental background levels of this microorganism. No adverse effects from dietary exposure have been attributed to natural populations of *Pseudomonas fluorescens* and none were observed during acute oral toxicity testing either with a formulation containing *Pseudomonas fluorescens* strain A506 or with a strain equivalent to the MPCA. There are no reports of mammalian toxins being produced by the MPCA. Furthermore, as Blightban A506 is applied to pome fruit trees at the flowering stage, *Pseudomonas fluorescens* strain A506 is not

expected to come into direct contact with fruit, and consequently, the food use pattern is unlikely to result in significant residues on fruit at the time of harvest. The establishment of an MRL is therefore not required for *Pseudomonas fluorescens* strain A506 under Section 4(d) of the FDA (adulteration of food) as defined under Division 15, Section B.15.002 of the Food and Drugs Regulations.

2.5 Methods for Determination of Relevant Impurities in the Manufactured Material

The quality assurance procedures used to limit contaminating microorganisms during manufacture of Blightban A506 are acceptable.

Contamination is monitored throughout manufacture using total plate counts on standard media following standard methods (incubation at 25°C). Gross contamination would also be distinguished by microscopic examination of the product.

The absence of human pathogens and below-threshold levels of contaminants are ensured throughout manufacture using pathogen specific media. Release standards for microbial contaminants in the end-use products comply with those permitted by the Agency and are adequate for the detection of human and animal microorganisms of concern (see 2.6 below).

2.6 Methods to Show Absence of Any Human and Mammalian Pathogens

As noted in Section 2.5, microbe-specific screening methods for enteric bacteria/total coliforms, yeasts/moulds, *Salmonella* spp., *Shigella* spp., *Staphylococcus* spp., *Vibrio* spp. and *Pseudomonas aeruginosa* are adequate for detecting and enumerating microbial contaminants of concern and to ensure that Blightban A506 does not contain unacceptable levels of human and animal disease-causing microorganisms.

2.7 Methods to Determine Storage Stability, Shelf-life of the Microorganism

Results from storage stability testing from four lots of Blightban A506 showed that the end-use product is stable for one week at 21°C. Alternatively, the end-use product is stable for 1 month at 4°C, or for up to 9 months at -27°C.

3.0 Impact on Human and Animal Health

3.1 Toxicity and Infectivity Summary

A survey of published literature identified several clinical cases of transfusion-related septicæmia caused by *Pseudomonas fluorescens* from contaminated blood products or intravenous fluids, or improper vene-puncture technique. Many of the cases occurred in patients who were severely immuno-compromised or cancer patients and had fatal outcomes. Certain clinical cases of *Pseudomonas fluorescens* bacteræmia were also linked to contaminated medical supplies, or the formation of biofilms in catheters or similar equipment. Other reports included a fatal case of neonatal sepsis caused by *Pseudomonas fluorescens* with no apparent conditions to

predispose the infant to infection, and a case of neonatal non-hematogenous osteomyelitis of the sternum following a sternotomy. There was also a case of osteolytic lesions in the upper extremities of an elderly cancer patient. Another case reported on *Pseudomonas fluorescens*-associated endophthalmitis in an eye that was punctured with a rusty metal spring. *Pseudomonas fluorescens* has also been identified as an emerging bacterial pathogen in patients with human immunodeficiency virus, and may play a role in pathogenesis of inflammatory bowel diseases.

While there have been some reports of clinical cases associated with *Pseudomonas fluorescens* infection, most of the cases were transfusion-related arising from contaminated intravenous products in compromised patients. *Pseudomonas fluorescens* strain A506 in Blightban A506 was originally obtained from healthy plant tissue, and while it cannot be stated without qualification that the exact strain in Blightban A506 occurs worldwide, it is likely that functionally equivalent strains of *Pseudomonas fluorescens* are distributed worldwide. Consequently, humans and other animals are considered to be continuously exposed to natural populations of *Pseudomonas fluorescens* by dermal exposure, and by ingestion of leafy plant materials, or fruits and vegetables or other edible plant organs. Given the prevalence of *Pseudomonas fluorescens* in the environment, the number of clinical cases associated with *Pseudomonas fluorescens* are considered very low. In general, *Pseudomonas fluorescens* is regarded as one of the least virulent members of Pseudomonaceae family, while *Pseudomonas aeruginosa* is regarded as the most common, and most virulent, pathogen of the family. The limited growth of *Pseudomonas fluorescens* strain A506 at temperatures > 37°C further reduces its potential as an opportunistic pathogen in humans.

Other reports pertained to the inflammatory potential of *Pseudomonas fluorescens*. As a gram-negative bacterium, lipopolysaccharide (LPS) in the cell wall of *Pseudomonas fluorescens* can elicit immune responses in response to the endotoxin. However, the inflammatory potential of LPS of *Pseudomonas fluorescens* was shown to be moderately reactive compared to *Streptococcus fecalis* and *Clostridium perfringens*, for example, which showed higher inflammatory reactions. Exposures to organic dusts, containing *Pseudomonas fluorescens* and other gram-negative bacteria, have led to respiratory disease, such as asthma, allergy, hypersensitivity pneumonitis and toxic pneumonitis (organic dust toxic syndrome).

The PMRA conducted a detailed review of the toxicological database submitted in support of *Pseudomonas fluorescens* strain A506. The database is largely complete, consisting of laboratory animal (in vivo) toxicity studies (acute oral toxicity, acute inhalation toxicity and dermal irritation; and acute oral toxicity, intraperitoneal injection) currently required for health hazard assessment purposes. A waiver request was deemed acceptable to address dermal toxicity in lieu of testing. In addition to the required studies, an eye irritation study using an isolate equivalent to the MPCA was also submitted. The scientific quality of the database is considered sufficient to characterize the toxicity of this pest control agent and product but the information available is insufficient to fully address the infectivity potential of *Pseudomonas fluorescens* strain A506. As a result, the Agency requires a full toxicity and infectivity guideline study using either the pulmonary instillation or intravenous route of administration to confirm the lack of infectivity potential of the MPCA.

The studies submitted for human health and safety testing for Blightban A506 were originally generated for the U.S. EPA's registration of a series of other products, namely Frostban A, Frostban B, Frostban C and Frostban D. The Frostban A formulation is such that it contains a mixture of three *Pseudomonas* spp. strains, namely *Pseudomonas fluorescens* strain A506 (Frostban B; equivalent to the Blightban A506 TGAI), *Pseudomonas syringae* strain 742RS (Frostban C), and *Pseudomonas fluorescens* strain 1629RS (Frostban D)) plus formulants. Consequently, the acute oral toxicity study and the intraperitoneal infectivity study submitted for Blightban A506 were conducted with Frostban A, rather than with the TGAI. However, the data were considered acceptable to support the toxicity requirements for Blightban A506 since Frostban A contains the MPCA in BlightBan A506, in addition to other species of *Pseudomonas* which are known to be more pathogenic than the MPCA (e.g., *Pseudomonas syringae*), and since the manufacturing process is such that there is no true TGAI for this end-use product. Furthermore, based on the level of dosing and the relative proportion of *Pseudomonas fluorescens* strain A506 in Frostban A, the administered doses were above the recommended doses for oral (10^8 CFU/animal) and intraperitoneal injection (10^7 CFU/animal) testing with an MPCA.

The test substance in the acute oral toxicity study, the acute inhalation toxicity, dermal irritation and eye irritation studies was *Pseudomonas fluorescens* strain AGS 3001.2 (also referred to as *Pseudomonas fluorescens* strain GJP17BR2). Since *Pseudomonas fluorescens* strain AGS3001.2 does not have any taxonomical differences to *Pseudomonas fluorescens* strain 1629RS, and since data from the Part 2 Product Characterization and Analysis database demonstrate that strain 1629RS and the MPCA are equivalent in their metabolic characteristics, strain 1629RS and Strain A506 can be considered very closely related. Furthermore, strain AGS3001.2 and Frostban A (containing strain A506) both showed low toxicity via the oral route, which demonstrates that strain AGS3001.2 and strain A506 can be considered toxicologically equivalent. Also, clinical cases of infection from *Pseudomonas fluorescens* in published literature have been opportunistic in nature, which suggests that *Pseudomonas fluorescens* is not a particularly invasive or virulent pathogen and further suggests lack of infectivity of the MPCA. Toxicity testing with strain AGS3001.2 is expected to provide relevant information on the toxicological nature of *Pseudomonas fluorescens* strain A506 and consequently, toxicity testing via the oral and inhalation routes of exposure, and dermal and eye irritation with *Pseudomonas fluorescens* Strain AGS3001.2 is considered acceptable. The U.S. EPA also accepted testing with *Pseudomonas fluorescens* strain AGS3001.2 in support of Frostban B (EPA Reg. No. 64004-2; PMRA 1393493).

In an acute oral toxicity study (limit test), fasted, Sprague-Dawley rats were given a single oral dose of Frostban A at 8.4×10^{10} CFU/animal (measured) and observed for 7 days. No mortalities occurred, and there were no signs of toxicity and no abnormalities upon gross necropsy. Frostban A was considered to be of low toxicity in the rat by the oral route. As no interim sacrifices for microbial enumeration of tissues/organs/body fluids were performed, infectivity of the MPCA was not assessed.

An acute oral toxicity study with *Pseudomonas fluorescens* strain AGS3001.2 was also conducted. Fasted, young adult Sprague-Dawley rats were given a single oral dose of undiluted strain AGS3001.2 at 5.0 g/kg bw and observed for 18 days. No mortalities occurred, there were no treatment related clinical signs, or necropsy findings, and all animals gained weight throughout the study. *Pseudomonas fluorescens* strain AGS3001.2 was considered to be of low toxicity to the rat by the oral route of exposure. Infectivity however, was not assessed directly.

In a pulmonary toxicity study, young Sprague-Dawley rats were exposed to undiluted strain AGS3001.2 at 5.3 mg/L (measured) for 4 hours by whole body exposure and observed for 14 days. No mortalities occurred. There were no unusual signs of toxicity reported other than expected signs of discomfort following inhalation exposure (all animals on Day 1 only) and slight corneal opacity in one animal (Day 2 only). *Pseudomonas fluorescens* strain AGS3001.2 was considered to be of low toxicity to the rat by the inhalation route of exposure. Infectivity however, was not assessed directly.

In an intraperitoneal injection study, Swiss Webster mice were injected with Frostban A at 2.1×10^8 CFU/animal (measured) and observed for 7 days. There were no mortalities. General toxicity after dosing was observed in all animals but had cleared in all but one female by Day 7. As no interim sacrifices for microbial enumeration of tissues/organs/body fluids were performed, infectivity of the MPCA was not assessed. Although guidelines recommend that bacterial MPCAs be tested by intravenous injection, testing via intraperitoneal injection was considered appropriate for Frostban A since the immune reaction to the LPS of gram-negative bacteria (such as *Pseudomonas fluorescens*) following an intraveous injection could mask any potential symptoms resulting from an actual infection by the MPCA.

In a dermal irritation study (limit test), six young adult male New Zealand white rabbits were exposed to 0.5 mL of undiluted *Pseudomonas fluorescens* strain AGS3001.2 for 4 hours at two shaved skin sites and observed for 14 days. Irritation was scored by the method of Draize (1965). Moderate erythema with very slight edema was noted until Day 2 after which signs of irritation tapered off to very slight erythema by Day 10 or sooner. All signs of irritation were resolved by Day 14 or sooner. *Pseudomonas fluorescens* strain AGS3001.2 was considered to be mildly irritating to the skin based on the Maximum Irritation Score (MIS) of 1.67. The signal words "CAUTION: Skin Irritant" are required on both the technical and the end-use product labels.

A request to waive dermal toxicity testing of Blightban A506 was based on the lack of toxicity of a substance equivalent to the MPCA via the oral, and inhalation routes of exposure, and a lack of toxicity with a formulation containing the MPCA (as well as other more pathogenic species such as *Pseudomonas syringae*), via the oral and intraperitoneal injection route of exposure. In particular, the inhalation exposure was by full body exposure (>24 hours) which is considered representative of dermal toxicity testing.

The results from dermal irritation testing were also considered. Precautionary labeling as a result from dermal irritation testing will alert users of the potential for dermal irritation ("Caution: skin irritant") from the technical and end-use products, and the requirement for personal protective equipment during all handling of Blightban A506 will further reduce the likelihood of occupational dermal exposure. These label statements are expected to adequately reduce the potential for dermal toxicity from Blightban A506. Furthermore, none of the formulants in the end-use product pose a concern with respect to dermal toxicity. For these reasons, dermal irritation testing with a test substance equivalent to the MPCA is considered acceptable in lieu of dermal toxicity testing with the end-use product and the waiver request was deemed acceptable.

In an eye irritation study (limit test), 0.1 mL of undiluted *Pseudomonas fluorescens* strain AGS3001.2 was instilled into the conjunctival sac of one eye of six young adult male New Zealand white rabbits and observed for 72 hours. Irritation was scored by the method of Driaze (1959). All animals experienced some sign of irritation up to the 24-hour timepoint, but all signs of irritation cleared in all treated eyes by 72-hours or sooner. Based on the Mean Average Score (MAS) of 2.56 and the MIS of 10.67 (at 1 hour), *Pseudomonas fluorescens* strain AGS3001.2 was classified as non- to minimally irritating to the eyes of rabbits.

Higher tier subchronic and chronic toxicity studies were not required because of the low acute toxicity of the MPCA and no obvious indications of infectivity toxicity or pathogenicity in the test animals treated in the Tier I acute oral, and intraperitoneal injection toxicity tests. Furthermore, a full toxicity and infectivity guideline study using either the pulmonary instillation or intravenous route of administration is required to confirm the lack of infectivity potential of the MPCA.

As previously mentioned, *Pseudomonas fluorescens* strain A506 is also a known sensitizing component of agricultural dusts due to the LPS found in the cell envelope of all gram-negative bacteria. There were two incidents of hypersensitivity reported which arose in workers after they were exposed to dust generated during product manufacture. Since the time of the incidents, certain modifications have been made to the manufacturing process to minimize worker exposure to the dust.

Within the available scientific literature, there are no reports that suggest that *Pseudomonas fluorescens* strain A506 has the potential to cause adverse effects on the endocrine system of animals. There were no obvious indications of infectivity in the submitted toxicity studies in the rodent via the oral, pulmonary, and intraperitoneal routes of exposure. Furthermore, an additional infectivity study is required to confirm the lack of infectivity potential of the MPCA. Based on the weight of evidence of available data, no adverse effects to the endocrine or immune systems are anticipated.

3.2 Occupational / Bystander Exposure and Risk Assessment

3.2.1 Occupational

When handled according to the label instructions, the potential routes of handler exposure to *Pseudomonas fluorescens* strain A506 are pulmonary, dermal and to some extent ocular, with the primary source of exposure to workers being dermal. Since unbroken skin is a natural barrier to microbial invasion of the human body, dermal absorption could occur only if the skin was cut, if the microbe was a pathogen equipped with mechanisms for entry through or infection of the skin, or if metabolites were produced that could be dermally absorbed. *Pseudomonas fluorescens* is not generally identified as a wound pathogen and there is no indication that it could penetrate intact skin of healthy individuals. As a strain equivalent to *Pseudomonas fluorescens* strain A506 showed mild irritation by the dermal route, precautionary labeling will notify users of the potential for dermal irritation, and the label requirement for personal protective equipment will further reduce the potential for dermal exposure.

Eye irritation from *Pseudomonas fluorescens* strain A506 is not expected based on results from testing.

The PMRA assumes that all microorganisms contain substances that can elicit positive hypersensitivity (allergic) reactions, and that individuals exposed to large quantities of *Pseudomonas fluorescens* strain A506 could possibly develop respiratory hypersensitivity upon repeated exposure to the product. Label statements (e.g., Potential Sensitizer) and risk mitigation measures are required to protect workers who are likely to be exposed to the products. Such exposure to workers can be minimized if they wear water proof gloves, long-sleeved shirts, long pants, shoes and socks, as well as a dust/mist filtering respirator/mask.

3.2.2 Bystander

Overall the Agency does not expect that bystander exposures will pose an undue risk on the basis of the low toxicity profile for *Pseudomonas fluorescens* strain A506 and the assumption that precautionary label statements will be followed in the use of Blightban A506 to minimize off-target spray drift.

The label does not allow applications to turf, residential or recreational areas; therefore, non-occupational dermal exposure and risks to adults, infants, and children are low. Because the use sites are agricultural, exposure to infants and children in school, residential and daycare facilities is likely to be minimal to non-existent. Consequently, the health risk to infants and children is expected to be negligible.

3.3 Dietary Exposure and Risk Assessment

3.3.1 Food

Blightban A506 is applied to pome fruit trees at the flowering stage; based on this timing of application, the proposed food use pattern is unlikely to result in significant residues on fruit at the time of harvest. While the proposed use pattern may result in some dietary exposure with possible residues in or on agricultural commodities, negligible to no risk is expected for the general population, including infants and children or animals because *Pseudomonas fluorescens* strain A506 demonstrated no oral toxicity at the maximum dose tested in the Tier I acute oral toxicity study. Also, *Pseudomonas fluorescens* species are ubiquitous in nature and have been isolated from a wide variety of environments (including orchards), with no adverse effects attributed to natural populations of *Pseudomonas fluorescens* reported from dietary exposure.

Furthermore, higher tiered subchronic and chronic dietary exposure studies are not required because of the low toxicity of the MPCA in the test animals treated in the Tier I acute oral and pulmonary toxicity studies. Therefore, there is no concern for chronic risks posed by dietary exposure of the general population and sensitive subpopulations, such as infants and children.

3.3.2 Drinking Water

Although *Pseudomonas fluorescens* strain A506 could enter neighbouring aquatic environments via spray drift or surface-water runoff, no risks are expected from exposure to this microorganism via drinking water because exposure will be minimal and there were no harmful effects observed in animals that were exposed orally in Tier I acute oral toxicity tests. The Blightban A506 label advises users to limit spray drift and surface-water runoff. The potential transfer of *Pseudomonas fluorescens* strain A506 to surface or groundwater during runoff is considered minimal to non-existent due in part to its percolation through, and resulting capture, in soil where *Pseudomonas fluorescens* is well-adapted for growth. The Blightban A506 label also instructs users not to contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes. Also, municipal treatment of drinking water will likely remove the transfer of residues to drinking water. Therefore, potential exposure to *Pseudomonas fluorescens* strain A506 in surface and drinking water is negligible.

3.3.3 Acute and Chronic Dietary Risks for Sensitive Subpopulations

Calculations of acute reference doses and acceptable daily intakes are not usually possible for predicting acute and long term effects of microbial agents in the general population or to potentially sensitive subpopulations, particularly infants and children. The single (maximum hazard) dose approach to testing MPCAs is sufficient for conducting a reasonable general assessment of risk if no significant adverse effects (i.e., no acute toxicity, infectivity or pathogenicity endpoints of concern) are noted in acute toxicity and infectivity tests. Based on all the available information and hazard data, the Agency concludes that *Pseudomonas fluorescens* strain A506 is of low toxicity, does not appear to be pathogenic or infective to mammals, and that infants and children are likely to be no more sensitive to the MPCA than the general

population. Thus there are no threshold effects of concern and, as a result, no need to require definitive (multiple dose) testing or apply uncertainty factors to account for intra- and interspecies variability, safety factors or margins of exposure. Further factoring of consumption patterns among infants and children, special susceptibility in these subpopulations to the effects of the MPCA, including neurological effects from pre- or post-natal exposures, and cumulative effects on infants and children of the MPCA and other registered micro-organisms that have a common mechanism of toxicity, does not apply to this MPCA. As a result, the Agency has not used a margin of exposure (safety) approach to assess the risks of *Pseudomonas fluorescens* strain A506 to human health.

3.4 Maximum Residue Limits

There were no signs of toxicity and no obvious signs of infectivity when the MPCA was administered orally to rats. No metabolic by-products of toxicological concern are produced by this microorganism. The establishment of an MRL is therefore not required for *Pseudomonas fluorescens* strain A506 under Section 4(d) of the FDA (adulteration of food) as defined under Division 15, Section B.15.002 of the Food and Drugs Regulation. The FDA prohibits the sale of adulterated food, that is, food containing a pesticide residue that exceeds the established MRL. Pesticide MRLs are established for FDA purposes through the evaluation of scientific data under the PCPA. Each MRL value defines the maximum concentration in ppm of a pesticide allowed in/on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

3.5 Aggregate Exposure

Based on the toxicity and infectivity test data submitted and other relevant information in the Agency's files, there is reasonable certainty that no harm will result from aggregate exposure of residues of *Pseudomonas fluorescens* strain A506 to the general Canadian population, including infants and children, when Blightban A506 is used as labeled. This includes all anticipated dietary (food and drinking water) exposures and all other non-occupational exposures (dermal and inhalation) for which there is reliable information. Dermal and inhalation exposure to the general public will be very low since the product is to be applied to outdoor agricultural sites only, and is not allowed for use on turf, residential or recreational areas. Furthermore, few adverse effects from exposure to other isolates of *Pseudomonas fluorescens* encountered in the environment have been reported. Even if there is an increase in exposure to this microorganism from the use of Blightban A506, there should not be any increase in potential human health risk.

3.6 Cumulative Effects

The Agency has considered available information on the cumulative effects of residues and other substances that have a common mechanism of toxicity. These considerations included the cumulative effects on infants and children of such residues and other substances with a common mechanism of toxicity. There are no strains of *Pseudomonas fluorescens* or closely-related species currently registered for pest control purposes in Canada. Besides other naturally occurring strains of *Pseudomonas fluorescens* in the environment, the Agency is not aware of

any other microorganisms, or other substances that share a common mechanism of toxicity. Therefore, no cumulative effects are anticipated if the residues of *Pseudomonas fluorescens* strain A506 interact with related strains of this microbial species.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

No studies were submitted to address the environmental fate and behaviour of *Pseudomonas fluorescens* strain A506. Environmental fate data (Tier II/III) are not required due to the absence of significant toxicological effects in non-target organisms in Tier I testing. Environmental fate testing is intended to demonstrate whether an MPCA is capable of surviving or replicating in the environment to which it is applied. These results could provide an indication of which non-target organisms may be exposed to the MPCA as well as provide an indication of the extent of exposure. Some information on the environmental fate of *Pseudomonas fluorescens* strain A506 is available in the published literature.

As the MPCA, *Pseudomonas fluorescens* strain A506 was originally isolated from a healthy pear leaf near Healdsburg, California, it is considered an indigenous phyllosphere bacterium. Other *Pseudomonas fluorescens* isolates have also been recovered from various plants (e.g., sugar beet, peas, olive, perennial rye, strawberries). In general, survival and proliferation of phyllosphere bacteria depends on various factors, such as the nature of the leaf surface, and most importantly, the ability of these microorganisms to protect themselves from drought and UV light by the production of pigments or by migrating into spaces between epidermal cells. Investigations with *Pseudomonas fluorescens* strain A506 specifically demonstrated that its persistence and colonization on snap bean plants is a function of the availability of carbohydrates.

Studies on the establishment and survival of *Pseudomonas fluorescens* strain A506 on apple leaves have been conducted under field conditions at 1×10^8 CFU/mL using a leaf imprint technique which assesses the percentage of leaf surface colonized over time. Studies showed that while approximately 30% of apple leaf was colonized by strain A506 an hour after spraying, this percentage decreased quickly thereafter to less than 10% 24 hours after spraying. Strain A506 could not be recovered on leaves at all after 48 hours.

Other biological strains performed better. *Pseudomonas fluorescens* strain P10c showed 60% colonization 1 hour after spraying, 40% colonization at 24 hours, and was not recovered at 48 hours. *Pantoea agglomerans* strains JLV07 and JLV08 performed even better with approximately 71% and 75% colonization 1 hour after spraying, respectively, which actually increased to 75% and 80% colonization, respectively, after 24 hours. At 48 hours, strains JLV07 and JLV08 showed 10% and 19% colonization, with a small percentage (5%) of the apple leaf still colonized by these strains 7 days after spraying. Colonization of strain A506 on pear leaves was even weaker. Less than 10% of pear leaves were colonized 1 hour post-application, and strain A506 could not be recovered from leaves at all thereafter. Pear leaves showed much better colonization with *Pseudomonas fluorescens* strain P10c. At 1 hour after spraying, strain P10c showed 70% colonization, 35% colonization at 24 hours, and 15% colonization at 48 hours.

Pantoae agglomerans strains were higher still. Both strains showed 90% colonization at 1 hour, then dropped to 65% colonization for strain JLV07, and 50% colonization for strain JLV08 at 24 hours, and finally to 32% colonization at 48 hours.

Overall, these results indicate that under field conditions, *Pseudomonas fluorescens* strain A506 is unlikely to survive on leaves for more than a couple of days.

While the phyllosphere seems to offer a harsh environment for growth of the MPCA, blossoms, on the other hand, provide a more favourable environment for *Pseudomonas fluorescens* colonization. The temperature growth range for *Pseudomonas fluorescens* strain A506 on flowers under laboratory conditions is approximately 12–35°C, with an optimum temperature for growth of 24°C. In the field, however, a temperature of approximately 10°C is more favourable for growth of the MPCA. At this temperature, populations of *Pseudomonas fluorescens* strain A506 were maintained at starting levels of 10^4 CFU/flower on stigmas for 12 days.

In greenhouse experiments, flower pistils supported the growth of strain A506 very well under optimum environmental conditions at ambient relative humidity, while growth on the nectaries (the glands which produce the nectar) was more fastidious with populations decreasing after approximately two days.

Blossom age is an important factor in the successful colonization of the MPCA on blossoms. Field experiments conducted with *Pseudomonas fluorescens* strain A506 at 10^8 CFU/mL gave rise to populations at 10^4 cells/flower on opened flowers, and populations increased to approximately 10^6 CFU/flower within 5 days. Even flowers that opened shortly after application were able to achieve populations of approximately 10^6 CFU/flower within 5–8 days. Populations progressively decreased as the flowers remained open, as moisture and nutrient levels declined.

Studies have shown that under field conditions, dispersal of biocontrol agents between trees is limited. Trees adjacent to treated trees do support population sizes similar to treated trees, trees that are two to three rows away showed population sizes at about half of the populations of treated trees. Seasonal variability was observed, however, indicating that successful secondary colonization depends on several factors, such as temperature immediately following treatment, bloom stage at time of treatment, and insect activity.

Typically, *Pseudomonas fluorescens* is associated with the plant rhizosphere. As rhizosphere bacteria, *Pseudomonas fluorescens* promotes plant growth, often by the suppression of plant pathogenic microorganisms, making *Pseudomonas* species well-suited as biocontrol agents.

Pseudomonas fluorescens has also been isolated in forest environments in British Columbia, such as from coastal and interior forest soil, and in association with Douglas fir roots. *Pseudomonas fluorescens* has also been recovered from fruiting bodies of the edible forest mushroom, *Cantharellus cibarius*.

A study has shown that vertical transport of *Pseudomonas fluorescens* through different soil types is not as much a function of the mobility of the microorganism itself, but of the physical properties of the soil (e.g., texture, and pore size) which determine the adsorption of bacteria. Even under conditions of continuous water flow, motility of the microorganism does not play an important role in vertical transport of *Pseudomonas fluorescens.* Instead it is the presence of fungal exudates, or chemoattractants (e.g., glucose), which promote transport through soil. Conversely, mobility of *Pseudomonas fluorescens* does play an important role in horizontal movement in the presence of chemical stimuli. Based on this information, *Pseudomonas fluorescens* strain A506 is expected to settle into soil environments rather than translocate through the soil.

Although not generally considered an aquatic microorganism, *Pseudomonas fluorescens* has been recovered from aquatic environments, such as stream water from southwestern Alberta and from deep granitic nutrient-poor groundwater. *Pseudomonas fluorescens* has also been recovered from the liver of a healthy goldfish. The isolate displayed antagonistic effects against the fish pathogen *Aeromonas hydrophilas*. Other *Pseudomonas fluorescens* isolates were recovered as commensal organisms from the gills of the brown trout.

4.2 Effects on Non-Target Species

4.2.1 Effects on Terrestrial Organisms

A honeybee contact toxicity study and a phytotoxicity study were submitted to address the hazards of the MPCA to terrestrial non-target organisms.

The honeybee toxicity study was generated on Frostban A , a formulation containing a mixture of three *Pseudomonas* spp. strains, including *Pseudomonas fluorescens* strain A506 (Frostban B), *Pseudomonas syringae* strain 742RS (Frostban C), and *Pseudomonas fluorescens* strain 1629RS (Frostban D) plus formulants. The study was considered acceptable to support toxicity testing of Blightban A506 to honeybees since Frostban A contains the MPCA, in addition to other *Pseudomonas* species which are known to be more pathogenic than the MPCA (e.g., *Pseudomonas syringae*), and since there are no concerns with respect to toxicity of the formulants in Blightban A506 to honeybees or to other non-target organisms.

In the honeybee contact toxicity study, Italian honeybees (*Apis mellifera*) were exposed to 5 µL of Frostban A at 1.03×10^5 CFU/bee, 2.06×10^5 CFU/bee, 4.12×10^5 CFU/bee, 8.25×10^5 CFU/bee or 1.65×10^6 CFU/bee by direct application to the thorax and observed daily for 6 days. A slight increase in mortality was observed at 4.12×10^5 CFU/bee and 8.25×10^5 CFU/bee dose levels. However, the cause of the deaths was not determined, and the increase in mortality coincided with a decline in food supply in these treatment groups only which may account for the findings. There were no other signs of significant toxicity reported for any of the honeybees. The estimated acute contact toxicity LD_{50} was $\geq 1.65 \times 10^6$ CFU/bee. Infectivity was not assessed. In addition, any bacteria that is carried back to the hive on exposed bees is not likely to survive under normal hive temperatures (32–36°C) since growth of *Pseudomonas fluorescens* strain A506 is inhibited at such high temperatures.

Moreover, published reports from field studies with honeybees provide useful evidence on the potential for toxicity from biological control agents under realistic exposure scenarios. Studies have shown that after foraging in trees treated with *Pseudomonas fluorescens* strain A506, honeybees did carry the MPCA, but despite this verified exposure, no adverse effects on the bees were noted. Based on this demonstrated lack of adverse effects in bees exposed to the MPCA under field conditions, it is not expected that the use of Blightban A506 will pose an unacceptable risk to honeybees under operational conditions of use.

In the phytotoxicity study, *Pseudomonas fluorescens* strain A506 was tested for phytopathogenicity in various host plants, including grains (barley, maize, oats, sorghum, wheat), vegetables (broccoli, cabbage, cauliflower, cucumber, snapbean) and fruit (citrus, peach, pear, tomato) and tobacco. *Pseudomonas fluorescens* strain 1629RS and *Pseudomonas syringae* strain MS742, the other two active ingredients in Frostban A, were also tested individually. Bacterial suspensions of 10^6 or 10^8 CFU/mL were tested using various inoculation methods depending on the host plant, including puncture wound, leaf swab, hole punch, and leaf infiltration. No signs of phytopathogenicity from *Pseudomonas fluorescens* strain A506 were observed in any of the host plants tested, including pear, the target crop for Blightban A506. Nor were there any phytotoxic effects observed from *Pseudomonas fluorescens* strain MS1629RS, which supports the toxicological equivalence of this strain to the *Pseudomonas fluorescens* strain A506. Given that the test doses were below the maximum label rate of 3.7×10^9 CFU/mL, and that protocols did not follow guidelines, the study was considered supplemental.

As a rhizosphere bacterium, *Pseudomonas fluorescens* is recognized as plant-growth promoting bacterium which often acts by suppressing plant pathogenic microorganisms or competitively colonizing plant roots. These qualities also make *Pseudomonas fluorescens* isolates well-suited as biocontrol agents for soil-borne pathogens. Various strains of *Pseudomonas* species have currently been developed as biological control agents against root, foliar, and post-harvest diseases, and the published literature reveals dozens of reports on the potential application of beneficial *Pseudomonas fluorescens,* in particular in agriculture. This information further supports the lack of toxicity and infectivity of *Pseudomonas fluorescens* to plants.

A request to waive environmental toxicity testing on avian species, wild mammals, and non-arthropod invertebrates was deemed acceptable based on the following rationale: *Pseudomonas fluorescens* is a ubiquitous microorganism in the environment and the proposed use pattern of Blightban A506 is not expected to considerably increase the natural background levels of *Pseudomonas fluorescens*. Testing at high doses with a formulation containing *Pseudomonas fluorescens* strain A506 (and other more pathogenic strains) demonstrated low toxicity in rats exposed by the oral route and in mice exposed by the intraperitoneal route, and testing with an isolate equivalent to *Pseudomonas fluorescens* strain A506 showed no toxicity in rats exposed by oral and inhalation exposure. Also, the normal body temperature of birds (> 40°C) and mammals (human and mice, 37°C; canine and feline, 38–39°C) are not conducive to growth of *Pseudomonas fluorescens* strain A506 which does not grow at temperatures >37°C. This further supports the lack of infectivity of the MPCA to birds and mammals. There has been only a single case of infection in domesticated birds reported in published literature, which demonstrates that adverse effects in terrestrial animals from natural populations of *Pseudomonas fluorescens* are

rare. Prominent clinical cases in humans linked to *Pseudomonas fluorescens* were mostly cases of septicæmia/bacteræmia related to contaminated transfusion products in immunocompromised hosts, or were related to occupational disease from exposure to LPS of gram-negative bacteria. *Pseudomonas fluorescens* strain A506 has been established as a pesticide in the United States since 1992 in climates comparable to those in Canada with no reports of adverse effects to non-target terrestrial animals. Together, this information was considered sufficient to adequately assess the environmental risk to non-target terrestrial organisms, including avian species, wild mammals, and non-arthropod invertebrates without the need for further testing.

Given that the MPCA is a natural constituent of the outdoor environment, *Pseudomonas fluorescens* strain A506 is not expected to affect environmentally or economically important microbial species or microbiologically-mediated biogeochemical processes. Consequently, even though Blightban A506 is intended to control pest microorganisms, effects data on non-target microorganisms are not required.

The use of Blightban A506 will be limited to foliar applications by airblast orchard sprayer or mist blower on apple and pear trees. This use pattern minimizes direct exposure to above-ground-dwelling terrestrial animals since birds and mammals would only be directly exposed to Blightban A506 by spray drift if they were in the vicinity during application. Exposure to non-target terrestrial organisms thereafter would be limited to contact with sprayed foliage, and consuming exposed plant parts or insects. Considering the background levels of *Pseudomonas fluorescens* in the environment, the increased environmental exposure to *Pseudomonas fluorescens* strain A506 due to use of the end-use product Blightban A506, is expected to be minimal.

Based on this information, the Agency is reasonably assured that the use of Blightban A506 will not present an unacceptable risk to terrestrial species, including avian animals, wild mammals, arthropods, non-arthropod invertebrates, and terrestrial plants.

4.2.2 Effects on Aquatic Organisms

Waiver requests were submitted to address requirements for toxicity testing on aquatic non-target organisms, including freshwater and marine fish, aquatic arthropods, and aquatic plants. The waiver requests were based on the fact that *Pseudomonas fluorescens* is a ubiquitous microorganism in the terrestrial environment and has only been occasionally recovered from ground and surface water and as a commensal organism from fish. Therefore aquatic ecosystems are known to be exposed to natural populations of *Pseudomonas fluorescens* but its occurrence in aquatic habitats is not widespread. A search of the published literature revealed only spurious reports of a possible association between *Pseudomonas fluorescens* and disease. One research article noted a *Pseudomonas* infection in white catfish that was caused by a bacterium closely related to *Pseudomonas fluorescens*. The isolate was also pathogenic to golden shiner (*Notemigonus chrysoleucas*), gold fish (*Carassius carassius*), and channel catfish (*Ictalarus punctatus*). Another early report described a *Pseudomonas* species closely resembling, but different from, *Pseudomonas fluorescens,* that was isolated from skin lesions of rainbow trout (*Salmo gairden*). *Pseudomonas fluorescens* has also been recovered from lesions on diseased,

farmed marine turtles but the significance of the bacterium in this case was not established. Other than these three cases of infection, there were no other reports in the published literature of adverse effects from *Pseudomonas fluorescens* in aquatic organisms. There is also a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target aquatic species under operational conditions of use.

The small number of reports of adverse effects in aquatic organisms associated with natural populations of *Pseudomonas fluorescens,* or organisms closely related to *Pseudomonas fluorescens,* despite its ubiquitous nature, suggests that adverse effects from the MPCA are unlikely to occur. In fact, there are reports of antagonistic effects from *Pseudomonas fluorescens* against certain fish pathogens in vitro (e.g., *Aeromonas hydrophila*; *Aeromonas salmonicida*) which suggests that *Pseudomonas fluorescens* may have a potential application in aquaculture. Other strains of *Pseudomonas fluorescens* have been studied as biological control agents against harmful winter algal bloom (caused by *Stephanodiscus hantzschii*) and red tide (caused by *Heterosigma akashiwo*).

The use of BlightBan A506 is limited to foliar applications in apple and pear orchards. Although this use pattern does not include any direct application to water, aquatic ecosystems may be indirectly exposed to the MPCA through rainwater wash-off of residues from treated foliage followed by run-off surface waterbodies. Leaching to groundwater is likely to be negligible given that *Pseudomonas fluorescens* does not demonstrate mobility in soil except in the presence of fungal exudates, or chemoattractants which promote transport through the soil column. *Pseudomonas fluorescens* is more likely to settle in soil rather than translocate to aquatic environments. Also, wash-off from the tree canopy through rainfall events is expected to be limited by the fact that *Pseudomonas fluorescens* strain A506 only survives for a couple of days on leaves under field conditions. Overall, this information strongly suggests that the amount of *Pseudomonas fluorescens* strain A506 reaching aquatic ecosystems as a result of operational use of Blightban A506 is expected to be minimal.

Based on these considerations, the use of Blightban A506 is not expected to present an unacceptable risk to aquatic species, including freshwater fish, aquatic arthropods, and aquatic plants.

5.0 Value

5.1 Effectiveness against Pests

5.1.1 Acceptable Efficacy Claims

5.1.1.1 Fire blight on apple

Fifteen trials were submitted in which disease pressure ranged from low to high. Two trials were considered invalid because the number of applications and application timing were not identified. Five out of the remaining thirteen trials reported results where disease levels in the treated trees were significantly lower than the control. Eight trials did not report significant differences although disease levels were generally reduced compared to the control. In some trials, trees adjacent to trees inoculated with *Erwinia amylovora* were also assessed for fire blight. In these cases, disease levels in the treated trees were too severe and prevented treatment differences from being observed. Six out of fifteen trials reported significant differences between the treated and control trees. All treatments containing *Pseudomonas fluorescens* A506 were applied from early bloom to 90% bloom.

When applied two times at 374 g/1000 L of water, BlightBan A506 significantly reduced the mean number of blighted clusters caused by fire blight by 38%. In trial 13, where fire blight was assessed in terms of number of strikes/tree, disease levels in treated and check trees inoculated with *Erwinia amylovora* were not significantly different (high disease pressure). However, in trees adjacent to inoculated trees where disease pressure was moderate, disease control based on mean number of blighted clusters, increased by 38-67% compared to controls at a rate of 528 g. At 704 g, fire blight was reduced by 72% in adjacent trees (low disease pressure).

A suspension of *Pseudomonas fluorescens* at 1 x 10^8 cfu/ml applied two to four times to run-off reduced the disease by 45.5% (trials 8 and 9). In the trials that did not report significant results, two to three applications of BlightBan A506 at 260-1348 g/1000 L water reduced fire blight incidence by an average of 35.3%. In two trials, applications of BlightBan A506 did not reduce disease levels compared to the control. In 8 of 13 trials, the antibiotic standard (streptomycin/oxytetracycline) performed better than BlightBan A506.

5.1.1.2 Fire blight on pear

Nine trials out of 10 were considered for review; one trial was invalid since the rate of application or concentration was not reported. There was low to high disease pressure in the trials. Four out of nine trials had significant differences. Four trials resulted in numerical reductions in disease levels while in one trial, disease levels in the BlightBan treated trees had the same disease level as the control plot.

When applied at the proposed rate of 374 g/1000 L of water, BlightBan A506 reduced fire blight by 34% but this difference was not significantly different from the control. Two applications at 528 g/1000 L significantly reduced fire blight incidence by 66% under moderate disease pressure. When applied twice at a concentration of 1 x 10^7 cfu/ml (equivalent to 1283 g/1000 L of water), disease incidence was reduced by 33%. This indicates that increasing the rate from 528 g to 1283 g/1000 L does not necessarily increase fire blight control.

An average of 41% control was obtained with two applications of a bacterial suspension consisting of 1 x 10^8 cfu/ml. Numerical reductions in disease levels averaged 33% across four of the trials. In one trial conducted in 2004, the same disease levels were obtained in the control and BlightBan treated trees. Generally, the antibiotic standard was superior to BlightBan A506.

5.2 Non-safety adverse effects

No phytotoxic effects were reported in any of the trials. A trial on FrostBan previously submitted to the EPA was also provided. This study was considered since the active ingredient in FrostBan is the same bacterial strain contained in BlightBan A506. Representative crops from four plant families (Poaceae, Fabaceae, Solanaceae, and Rosaceae) were tested. Results of the pathogenicity tests demonstrated that no phytotoxic responses were observed in 13 of the 14 crops tested. In sorghum (cultivar NK1580), *Pseudomonas fluorescens* A506 produced a reaction that was similar to the heterologous pathogens, *Pseudomonas syringae* pv. *syringae* J900 and *Pseudomonas syringae* pv. *lachrymans* P1589. No details were provided regarding this reaction.

5.3 Economics

No market analysis was done for this submission.

5.4 Sustainability

5.4.1 Survey of Alternatives

The alternative ingredients registered for control or suppression of fire blight caused by *Erwinia amylovora* are presented in Appendix 1, Table 3.

5.4.2 Compatibility with Current Management Practices Including Integrated Pest Management

BlightBan A506 has been shown to be compatible with streptomycin. Fire blight incidence in pear trees treated with a mixture of antibiotics (applied at 50% frequency or every other spray) and *Pseudomonas fluorescens* A506 was lower than those treated with antibiotics alone. However, the presence of *Pseudomonas fluorescens* A506 did not lower disease incidence when the antibiotic treatments were applied at 100% frequency. This indicates that *Pseudomonas fluorescens* A506 can be used in an integrated fire blight management program where antibiotic applications are reduced.

Pseudomonas fluorescens A506, the active ingredient in BlightBan A506, produces an extracellular protease that inhibits antibiotics produced by *Pantoea agglomerans* strain C9-1, the active ingredient in BlightBan C9-1 (Reg. No. 28392) and *Pantoea agglomerans* strain Eh252. BlightBan C9-1 is registered for suppression of fire blight of apples and pears. BlightBan A506 is being registered for the same use. An additional statement has been added to the label to inform users against sequential applications of BlightBan A506 and BlightBan C9-1.

5.4.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance

The level of risk of fire blight populations developing resistance to BlightBan A506 is unknown. BlightBan A506 is a biological pesticide and its active ingredient, *Pseudomonas fluorescens* strain A506 effectively colonizes the flowers and other parts of trees after applications, and competitively displaces the fire blight pathogen, *Erwinia amylovora*.

Pseudomonas fluorescens was isolated from pear and it antagonizes the fire blight pathogen through competition for space and nutrition. This mode of action is not expected to contribute to the development of resistant strains of *Erwinia amylovora* populations.

5.4.4 Contribution to Risk Reduction and Sustainability

Fire blight is currently managed by cultural practices such as removal of diseased limbs during the dormant stage, growing relatively tolerant cultivars, and chemical controls such as the use of a growth regulator, streptomycin and copper based fungicides/bactericides.

Streptomycin 17, Apogee and copper-based fungicides/bactericides are registered in Canada for control of fire blight. Streptomycin 17 is used frequently and is prone to development of resistance in the fire blight pathogen. Consequently, there is a need for alternative products in fire blight management to reduce the use of streptomycin. BlightBan A506 can be used as a companion product with streptomycin in an integrated fire blight suppression program such as integrated pest management (IPM).

BlightBan A506 can contribute to the suppression of fire blight on pears and apples. Use of BlightBan A506 in an IPM program could lead to a reduction in the use of streptomycin and consequently in worker and environmental exposure to streptomycin.

6.0 Pest Control Product Policy Considerations

6.1 Toxic Substances Management Policy Considerations

The management of toxic substances is guided by the federal government's *Toxic Substances Management Policy*, which puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key

management objectives is virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances.

While reviewing *Pseudomonas fluorescens* strain A506, the PMRA took into account the federal Toxic Substances Management Policy and followed its Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*. Substances associated with its use were also considered, including microcontaminants in the technical product, *Pseudomonas fluorescens* strain A506 technical and formulants in the end-use products Blightban A506. The PMRA has reached the following conclusions:

- *Pseudomonas fluorescens* strain A506 technical does not meet the Track 1 criteria because the active ingredient is a biological organism and hence is not subject to the criteria used to define persistence, bioaccumulation and toxicity properties of chemical control products. There are also no formulants, contaminants or impurities present in the end-use product Blightban A506 that would meet the TSMP Track-1 criteria.

- *Pseudomonas fluorescens* strain A506 Technical does not contain any contaminants of health or environmental concern identified in Canada Gazette part II, Volume 139, Number 24, pages 2641-2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern.*

Therefore, the use of *Pseudomonas fluorescens* strain A506 Technical is not expected to result in the entry of Track 1 substances into the environment.

6.2 Formulants and Contaminants of Health or Environmental Concern

The technical product contains soy, and the end- use product contains lactose (milk), both of which are identified in Canada Gazette Part II, Volume 139, Number 24, pages 2641-2643: *List of Pest Control Product Formulants of Health or Environmental Concern* as allergens known to cause anaphylactic type reactions. Therefore, the label for the technical includes the precautionary statement "Warning: contains the allergen soy " on the principal display panel. Similarly, the label for the end-use product includes the precautionary statement "Warning: contains the allergens soy and lactose (milk)" on the principal display panel.

7.0 Summary

7.1 Methods for Analysis of the Microorganism as Manufactured

The product characterization data for *Pseudomonas fluorescens* strain A506 technical and Blightban A506 are adequate to assess their safety to human health and the environment. The technical material was fully characterized and the specifications were supported by the analysis of a sufficient number of batches.

Although a protein electrotyping method with immunofluorescent staining was found to be acceptable for strain-specific identification of *Pseudomonas fluorescens* strain A506, an image of the gel with better resolution is required to confirm that the method satisfies the requirement. In the event that this method does not prove to satisfy the requirements, detailed methodology on the RFLP fingerprint method with PFGE will be required.

Storage stability data were sufficient to support an expiration date of one week at 21°C, or 1 month at 4°C, or up to 9 months at -27°C.

7.2 Human Health and Safety

A formulation containing the MPCA, Frostban A, was of low toxicity in the rat by the oral route and there were no mortalities in mice injected intraperitoneally with Frostban A. However, infectivity was not assessed by either route.

A strain toxicologically equivalent to *Pseudomonas fluorescens* strain A506, *Pseudomonas fluorescens* strain AGS3001.2, was of low toxicity to the rat by the oral and pulmonary route of exposure and was non- to minimally irritating to the eyes of rabbits. As *Pseudomonas fluorescens* strain AGS3001.2 is mildly irritating to the skin of rabbits, the signal words "CAUTION: Skin Irritant" are required on the technical and end-use product labels.

The request to waive dermal toxicity testing of Blightban A506 was accepted based on the lack of toxicity of *Pseudomonas fluorescens* strain AGS3001.2 via the oral route of exposure and the inhalation routes of exposure. Furthermore, Frostban A demonstrated a lack of toxicity via the oral and intraperitoneal injection route of exposure. Also, the label statements imposed as a result of dermal irritation testing and the standard label statements for personal protective equipment are expected to adequately reduce the potential for dermal toxicity from Blightban A506. Moreover, none of the formulants in the end-use product pose a concern with respect to dermal toxicity.

Although the acute toxicity and infectivity studies submitted in support of *Pseudomonas fluorescens* strain A506 were considered sufficient to characterize the toxicity of this pest control agent and product, it was insufficient to fully address the infectivity potential of *Pseudomonas fluorescens* strain A506. As a result, a full toxicity and infectivity guideline study using either the pulmonary instillation or intravenous route of administration is required as a condition of registration to confirm the lack of infectivity potential of the MPCA.

The technical product contains soy, and the end- use product contains lactose (milk), both of which are allergens known to cause anaphylactic type reactions. Therefore, the labels for the technical and end-use products include the precautionary statements "Warning: contains the allergen soy "and "Warning: contains the allergens soy and lactose (milk)" on the principal display panel, respectively.

When handled according to label instructions, the potential routes of handler exposure are pulmonary, dermal and to some extent ocular, with the primary source of exposure to workers being dermal. Adverse effects from the inhalation and ocular routes of exposure are not expected based on results from testing. As a strain equivalent to *Pseudomonas fluorescens* strain A506 showed mild irritation by the dermal route, precautionary labelling identifies the technical and end-use products as skin irritants. Furthermore, to reduce the potential for dermal exposure, the labels specify that users wear appropriate personal protective equipment and early-entry workers are restricted from entering areas where Blightban A506 has been applied for a period of 4 hours unless wearing the indicated personal protective equipments.

The PMRA assumes that all microorganisms contain substances that can elicit positive hypersensitivity reactions, and that exposure to allergens, including *Pseudomonas fluorescens* strain A506 may cause allergies following repeated exposures. As a result, the signal words "Potential Sensitizer" are required on the principal display panels of all microbial technical and end-use products. Furthermore, personal protective equipment, including a NIOSH-approved respirator, are required to protect users that are likely to be primarily exposed to the products.

The label does not allow applications to turf, residential or recreational areas. Because the use sites are limited to agricultural settings, exposure to infants and children in school, residential and daycare facilities is likely to be minimal to non-existent. Consequently, the health risk to infants and children is expected to be negligible.

Given that *Pseudomonas fluorescens* strain A506 demonstrated low toxicity at the maximum dose tested in the Tier I acute oral toxicity study, as well as the timing of application of Blightban A506, and that there are no reports of mammalian toxins being produced by the MPCA and no adverse effects have been attributed from dietary exposure to natural populations of *Pseudomonas fluorescens*, it is unlikely that the food use pattern will result in significant residues on fruit at the time of harvest. Therefore, negligible to no risk is expected for the general population, including infants and children or animals, and consequently, the establishment of an MRL is not required for *Pseudomonas fluorescens* strain A506 under Section 4(d) of the *Food and Drugs Act* (adulteration of food), as defined under Division 15, Section B.15.002 of the Food and Drug Regulations.

7.3 Environmental Risk

Adverse effects in non-target terrestrial organisms were assessed from a phytotoxicity study conducted with *Pseudomonas fluorescens* strain A506 and a honeybee contact toxicity study conducted with a formulation containing *Pseudomonas fluorescens* strain A506. The phytotoxicity study showed no signs of phytotoxicity in any grains, vegetables, fruit and tobacco species tested. The honeybee toxicity test showed an increase in mortality of honeybees at the levels $\geq 4.12 \times 10^5$ CFU/bee. However, given that laboratory studies represent worst-case exposure conditions; that normal hive temperatures will inhibit growth of the MPCA; and that field studies conducted with *Pseudomonas fluorescens* strain A506 demonstrated a lack of adverse effects to bees under operational exposure conditions, the use of Blightban A506 is not expected to pose an unacceptable risk to honeybees.

The request to waive toxicity testing on terrestrial non-target organisms (including avian species, wild mammals, and non-arthropod invertebrates) was accepted based on the rationale that *Pseudomonas fluorescens* is a ubiquitous microorganism in the environment, and the proposed use pattern of Blightban A506 is not expected to considerably increase the natural background levels of *Pseudomonas fluorescens;* toxicity studies which support a lack of toxicity of *Pseudomonas fluorescens* strain A506 in laboratory animals by the oral, intraperitoneal, and inhalation routes of exposure; the normal body temperature of many terrestrial animals are not conducive to growth of the MPCA; only one case of infection in animals was reported in published literature which demonstrates that adverse effects in terrestrial animals from natural populations of *Pseudomonas fluorescens* are rare; and the history of use of *Pseudomonas fluorescens* strain A506 as a biological control agent in the United States since 1992 without reports of adverse effects to terrestrial organisms.

A request to waive toxicity testing on aquatic non-target organisms (including freshwater and marine fish, aquatic arthropods, and aquatic plants) was accepted based on the rationale that *Pseudomonas fluorescens* is a ubiquitous microorganism in the environment and has only been recovered occasionally from aquatic ecosystems; there were very few reports of infection or disease in association with *Pseudomonas fluorescens* in aquatic organisms in published literature; the amount of *Pseudomonas fluorescens* strain A506 reaching aquatic ecosystems as a result of the terrestrial use of Blightban A506 is expected to be minimal; and the history of use of *Pseudomonas fluorescens* strain A506 as a biological control agent in the Unites States since 1992 without reports of adverse effects to aquatic organisms.

7.4 Value

The data submitted to register BlightBan A506 demonstrates that it suppresses fire blight of apples and pears. BlightBan A506 may be applied at a rate of 370–530 g product/ha in 1000–2000 L of water, with a maximum of 3 applications per season for suppression of fire blight on pears and apples. The first application should be made at 15–20% bloom followed by a second application at first petal fall to full bloom and a third application at "rattail" bloom for pear or post petal fall for apples. The high rate should be used under conditions that promote rapid disease development. Applications require thorough coverage.

8.0 Regulatory Decision

Health Canada's PMRA, under the authority of the PCPA and Regulations, has granted conditional registration for the sale and use of *Pseudomonas fluorescens* strain A506 and Blightban A506, containing the technical grade active ingredient *Pseudomonas fluorescens* strain A506, to control fire blight on apples and pears.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risks and value have been found acceptable when all risk-reduction measures are followed, as a condition of these registrations, additional scientific information is being requested from the applicant. For more details, refer to the Section 12 Notice associated with these conditional registrations.

Product Characterization and Analysis

- To confirm that the protein electrotyping method satisfies the requirement for a strain-specific identification method for the MPCA, the registrant is required to provide an image of the gel. In the event that the protein electrotyping method does not fully satisfy the requirements, detailed methodology on the RFLP fingerprint method with PFGE will be required.

Human Health

- To confirm the lack of infectivity potential of *Pseudomonas fluorescens* strain A506, the registrant is required to provide a full toxicity and infectivity guideline study using either the pulmonary instillation or intravenous route of administration.

NOTE: The PMRA will publish a consultation document at the time when there is a proposed decision on applications to convert these conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

List of Abbreviations

°C	degree(s) Celcius
ATCC	American Type Culture Collection
bw	body weight
CFU	colony forming units
cm	centimeter
DACO	data code
e.g.	for example
FDA	*Food and Drugs Act*
g	gram
g/cm^3	grams per centimetre cubed
g/kg bw	grams per kilogram body weight
HIV	human immunodeficiency virus
hr, hrs	hour, hours
kg	kilograms
LD_{50}	lethal dose 50%
LPS	lipopolysaccharide
MAS	maximum average score
MERFLP	multiple enzyme restriction fragment length polymorphism
MIS	maximum irritation score
mL	millilitre
MPCA	microbial pest control agent
MRL	maximum residue limit
NIOSH	National Institute of Occupational Safety and Health
PCPA	*Pest Control Products Act*
PFGE	pulsed field gel electrophoresis
PMRA	Pest Management Regulatory Agency
ppm	part per million
RFLP	restriction fragment length polymorphism
TGAI	technical grade of the active ingredient

Appendix I Tables and Figures

Table 1 Toxicity and Infectivity of *Pseudomonas fluorescens* Strain A506 and Its Associated End-use Product Blightban A506

Study Type	Species, Strain, and Doses	Results	Significant Effects and Comments	Reference(s)
Acute Toxicity/Infectivity of *Pseudomonas fluorescens* Strain A506[1]				
Acute Oral Toxicity – Limit test	Rat –Sprague-Dawley 5/sex undiluted *Pseudomonas fluorescens* strain AGS3001.2 at 5.0 g/kg bw No control groups Observed for 18 days	Acute oral LD50 > 5.0 mg/kg bw (males, females)	-potency not reported -no mortalities no significant toxicity, no treatment related clinical signs, no necropsy findings or changes in bw LOW TOXICITY ACCEPTABLE	PMRA 1393488
Acute Pulmonary Toxicity- Limit Test	Rat –Sprague-Dawley 5/sex undiluted *Pseudomonas fluorescens* strain AGS3001.2 at 5.3 g/kg bw for 4 hours (whole body exposure) No control groups Observed for 14 days	Acute pulmonary LD50 >5.3 mg/L (males, females)	-potency not reported -no mortalities -general signs of discomfort in all animals on Day 1 only -slight corneal opacity in one animal on Day 2 only LOW TOXICITY ACCEPTABLE	PMRA 1393490
Acute Dermal Irritation-	Rabbit- New Zealand White (6 male animals) 0.5 mL undiluted *Pseudomonas fluorescens* strain AGS3001.2 to two shaved sites on back for 4 hours Observed for 14 days	MIS= 1.67	-moderate erythema with very slight edema u p to Day 2 -all signs of irritation were resolved by Day 14 or sooner MILD SKIN IRRITANT ACCEPTABLE	PMRA 1393492

Study Type	Species, Strain, and Doses	Results	Significant Effects and Comments	Reference(s)
Acute Dermal Toxicity- Waiver	Waiver submitted. The waiver request was based on the lack of toxicity of a strain equivalent to the MPCA via the oral route, and via the inhalation routes of exposure which was a full body exposure for >24 hours; and on a lack of toxicity of a formulation containing the MPCA (as well as other more pathogenic species, such as *P. syringe*) via the oral and intraperitoneal injection routes of exposure. Furthermore, the label statements imposed from dermal irritation testing and standard label statement for personal protective equipment will to adequately reduce the potential for dermal toxicity from Blightban A506, and none of the formulants in the end-use product poses a concern with respect to dermal toxicity. WAIVER ACCEPTED			PMRA 1393487
Eye Irritation- Limit Test	Rabbit- New Zealand White (6 male animals) 0.1 mL undiluted *Pseudomonas fluorescens* strain AGS3001.2.into one eye The other eye served as the untreated control Eyes were not washed out Observed for 72 hrs	MIS (1 h)= 10.67 MAS= 2.56	-potency not reported -in all animals: some sign of irritation (opacity; swelling of the iris, slight erythema/swelling, discharge in the conjunctivae) up to 24 hrs -all signs cleared by 72 hrs or sooner NON- TO MINIMALLY IRRITATING ACCEPTABLE	PMRA 1393495
Acute Toxicity/Irritation of Blightban A506[2]				
Acute Oral Toxicity – Limit Test	Rat –Sprague-Dawley 10/sex of Frostban A in phosphate buffer at 8.4×10^{10} CFU/animal (measured) Vehicle control group Observed for 7 days	acute LD50 $> 8.4 \times 10^{10}$ CFU/animal (males, females)	-no mortalities no significant toxicity, no signs of toxicity and no abnormalities upon gross necropsy -did not meet the recommended observation period of 21 days LOW TOXICITY ACCEPTABLE BUT SUPPLEMENTAL	PMRA 1393489

Study Type	Species, Strain, and Doses	Results	Significant Effects and Comments	Reference(s)
Acute Infectivity– Intraperitoneal Injection	Mouse –Swiss Webster 5/sex Frostban A in phosphate buffer at 2.0×10^8 CFU/animal (measured) Vehicle control group Observed for 7 days	n/a, as infectivity was not assessed	-no mortalities -in all animals: general signs of toxicity (scruffy coats, discharge from eyes, lethargy, diarrhea) immediately after dosing -all signs had cleared by Day 7, except in one female animal (minor scruffy coat) -tested by intraperitoneal rather than by intravenous injection was acceptable given that an intravenous injection of the MPCA may cause an immune reaction (due to the LPS) which could mask symptoms of infection -did not meet the recommended observation period of 21 days -no interim sacrifices; infectivity was not assessed ACCEPTABLE BUT SUPPLEMENTAL	PMRA 1393491

bw: body weight
hr., hrs.= hour, hours
n/a: not applicable
[1] Testing was conducted with *Pseudomonas fluorescens* strain AGS3001.2, a strain considered equivalent to the MPCA (*Pseudomonas fluorescens* strain A506) rather than with the MPCA itself
[2] Testing was conducted with Frostbans A, a mixture containing the MPCA, as well as other *Pseudomonas* species which are known to be more pathogenic than the MPCA (e.g., *Pseudomonas syringae*), rather than with Blightban A506 itself

Table 2 Toxicity to Non-Target Species

Organism	Exposure	Test Substance	Endpoint Value	Significant Effects and Comments	Reference(s)
Terrestrial Organisms					
Vertebrates					
Birds	Oral Pulmonary	No study was submitted. The waiver request was based on the proposed use pattern which is not expected to considerably			PMRA 1393496[1]

Organism	Exposure	Test Substance	Endpoint Value	Significant Effects and Comments	Reference(s)
	Injection	increase the natural background levels of the MPCA; the low toxicity profile of the MPCA from the Tier I acute oral and pulmonary toxicity studies; the normal body temperature of birds which is are not conducive to growth of *Pseudomonas fluorescens* strain A506; the literature reported only a single report of infection in domesticated birds, and no adverse effects in wild bird populations, despite the ubiquitous nature of the MPCA; and the is a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target terrestrial animals, including birds. WAIVER ACCEPTED			
Wild mammals	Acute	No study was submitted. The waiver request was based on the proposed use pattern which is not expected to considerably increase the natural background levels of the MPCA; the low toxicity profile of the MPCA from the Tier I acute oral and pulmonary toxicity studies; the normal body temperatures of many mammals which are not conducive to growth of *Pseudomonas fluorescens* strain A506; the literature reported only a single report of infection to terrestrial animals (domesticated birds) which demonstrates that adverse effects in terrestrial animals from natural populations of *Pseudomonas fluorescens* are rare; and there is a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target terrestrial animals, including wild mammals. WAIVER ACCEPTED			
Invertebrates					
Honeybees (Italian honeybees, *Apis mellifera*)	Contact Toxicity–Laboratory study	Contact exposure to 5 µL of Frostban A[2] at one of five concentrations: 1.03×10^5 CFU/bee 2.06×10^5 CFU/bee 4.12×10^5 CFU/bee 8.25×10^5 CFU/bee or 1.65×10^6 CFU/bee An untreated control group and a vehicle control group were included	An slight increase in mortality was observed after 74 hours at 4.12×10^5 CFU/bee and 8.25×10^5 CFU/bee dose levels. Estimate acute contact $LC_{50} \geq 1.65 \times 10^6$ CFU/bee	-cause of death was not established -the increase in mortality coincided with a decline in food supply in these test groups only -recovery of A506 was not attempted, therefore infectivity was not assessed NOT TOXIC ACCEPTABLE	PMRA 1393499

Organism	Exposure	Test Substance	Endpoint Value	Significant Effects and Comments	Reference(s)
		Viability was not assessed Observed for 6 days			
Non-arthopod in-vertebrates (e.g., earthworms)	Acute	No study was submitted. The waiver request was based on the proposed use pattern which is not expected to considerably increase the natural background levels of the MPCA; the low toxicity profile of the MPCA from the Tier I acute oral and pulmonary toxicity studies; literature reported only a single case of infection to terrestrial animals (domesticated birds), which demonstrates that adverse effects in terrestrial animals from natural populations of *Pseudomonas fluorescens* are rare; and the history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target terrestrial animals, including non-arthropod invertebrates. WAIVER ACCEPTED			PMRA 1393496[1]
Soil microbes	Acute	No study or waiver submitted. Effects data on non-target microorganisms are not required since the MPCA is a natural constituent of the outdoor environment.			n/a
Vascular Plants					
Vascular plants	Acute	MPCA in phosphate buffer at 10^6 or 10^8 CFU/mL, or both Tested plants: barley, maize, oats, sorghum, wheat, broccoli, cabbage, cauliflower, cucumber, snapbean and citrus, peach, pear, tomato and tobacco Inoculation methods: puncture wound, leaf swab, hole punch, and leaf infiltration, depending on host	No signs of Phyto-pathogenicity observed	-test doses were below the maximum label rate of 3.7×10^9 CFU/mL -protocols did not follow guidelines NOT PATHOGENIC TO PLANTS SUPPLEMENTAL	PMRA 1393501

Organism	Exposure	Test Substance	Endpoint Value	Significant Effects and Comments	Reference(s)
Aquatic Organisms					
Vertebrates					
Freshwater fish	Acute	No study was submitted. The waiver request was based on the ubiquitous nature of the MPCA as a terrestrial microorganism, which has only occasionally been recovered from aquatic ecosystems; literature reported only a few cases of infection related to *Pseudomonas* in aquatic species (fish, marine turtles) which demonstrates that adverse effects in aquatic species from natural populations of *Pseudomonas fluorescens* are rare; and the proposed terrestrial use pattern minimizes direct exposure to non-target aquatic organisms. Furthermore, the amount of *Pseudomonas fluorescens* strain A506 reaching aquatic ecosystems as a result of operational use of Blightban A506 is expected to be minimal, and there is a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target aquatic species, including freshwater fish species. WAIVER ACCEPTED		PMRA 1393496[1]
Estuarine/ marine fish	Acute	No study or waiver was submitted. Based on the use pattern, estuarine and marine fish are not expected to be exposed to the MPCA.			n/a
Invertebrates					
Non-arthropod invertebrates	Acute	No study was submitted. The waiver request was based on the ubiquitous nature of the MPCA as a terrestrial microorganism, which has only occasionally been recovered from aquatic ecosystems; literature reported only a few cases of infection related to *Pseudomonas* in aquatic species (fish, marine turtles) which demonstrates that adverse effects in aquatic species from natural populations of *Pseudomonas fluorescens* are rare; and the proposed terrestrial use pattern minimizes direct exposure to non-target aquatic organisms. Furthermore, the amount of *Pseudomonas fluorescens* strain A506 reaching aquatic ecosystems as a result of operational use of Blightban A506 is expected to be minimal, and there is a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target aquatic species, including aquatic non-arthropod invertebrates. WAIVER ACCEPTED		PMRA 1393496[1]

Organism	Exposure	Test Substance	Endpoint Value	Significant Effects and Comments	Reference(s)
Aquatic Plants					
Algae Freshwater plants	Acute	No study was submitted. The waiver request was based on the ubiquitous nature of the MPCA as a terrestrial microorganism, which has only occasionally been recovered from aquatic ecosystems; literature reported only a few cases of infection related to *Pseudomonas* in aquatic species (fish, marine turtles) which demonstrates that adverse effects in aquatic species from natural populations of *Pseudomonas fluorescens* are rare; and the proposed terrestrial use pattern minimizes direct exposure to non-target aquatic organisms. Furthermore, the amount of *Pseudomonas fluorescens* Strain A506 reaching aquatic ecosystems as a result of operational use of Blightban A506 is expected to be minimal, and there is a history of use of the MPCA in the U. S. since 1992 with no reports of adverse effects to non-target aquatic species, including aquatic plants. WAIVER ACCEPTED			PMRA 1393496[1]

n/a: not applicable

[1] A single report addressing the data waiver request for the outstanding environmental toxicity studies was submitted.

[2] Testing was conducted with Frostban A, a mixture containing the MPCA, as well as other *Pseudomonas* species which are known to be more pathogenic than the MPCA (e.g., *Pseudomonas syringae*), rather than with Blightban A506 itself.

Table 3 Alternative Active Ingredients Registered for Control or Suppression of Claimed Diseases on the Blightban A506 Accepted Label

Crop	Disease Claim	Active Ingredient
Apple	Fire blight	Copper, prohexadione calcium, *Pantoea agglomerans* strain E325, *Bacillus subtilis* strain QST 713, streptomycin
Pear	Fire blight	Copper, *Pantoea agglomerans* C9-1, *Pantoea agglomerans* strain E325, *Bacillus subtilis* strain QST 713, streptomycin

Table 4 Use (Label) Claims Proposed by Applicant and Whether Acceptable or Unsupported

Label Claims Proposed by Registrant with Original Application	Accepted Label Claims	Unsupported Label Claims and Comments
Fire blight on apple	Accepted with modifications. A rate range of 370-530 g/ha was supported instead of a single rate (370 g/ha).	
Fire blight on pear	Accepted with a modification to the application rate. A rate range of 370-530 g/ha was supported instead of a single rate (370 g/ha).	

References

A. List of Studies/Information Submitted by Registrant

1.0 METHODS OF ANALYSIS

PMRA Document Number: 1378272
Reference: 2007, Data Numbering Code M2.1-M2.6, Data Numbering Code: M2.1, M2.2, M2.3, M2.4, M2.5, M2.6

PMRA Document Number: 1378278
Reference: 1992, US EPA Pesticide Fact Sheet: Frostban A, Data Numbering Code: M2.12, M2.14

PMRA Document Number: 1378279
Reference: American Type Culture Collection, 2006, ATCC Number 31948. Product Description, Data Numbering Code: M2.7.1

PMRA Document Number: 1378280
Reference: 2007, Data Numbering Code M2.7.1 Origin And Derivation And Identification Of MPCA, Data Numbering Code: M2.7.1, M8.0, M9.0

PMRA Document Number: 1378281
Reference: Lindow, S.E, 1984, Microorganism Inhibition Of Frost Damage To Plants. US Patent 4,432,160, A01G 1/00, California, US, Data Numbering Code: M2.7.1

PMRA Document Number: 1378282
Reference: Yamamoto, S. et al, 2000, Phylogeny Of The Genus Pseudomonas: Intrageneric Structure Reconstructed From The Nucleotide Sequences Of Gyrb And Rpod Genes, *Microbiology* (reading, England) 146: 2385-2394, Data Numbering Code: M2.7.1

PMRA Document Number: 1378283
Reference: Stanier, R.Y. et al, 1966, The Aerobic Pseudomonads: A Taxonomic Study, *Journal Of General Microbiology* (1966) 43: 159-271, Data Numbering Code: M2.7.1

PMRA Document Number: 1378284
Reference: 1990, SACB Review Of Data/information Submitted By Frost Technology Corporation To Support An Experimental Use Permit For Frostbantm (EPA ID No. 064004-eup-001; Case No. 194638; Submission No. S288828; Caswell No. 714g And 714f, HED Project No. 0-1872), Data Numbering Code: M12.5, M2.7.1

PMRA Document Number: 1378285
Reference: US EPA, 2006, Frost-preventing Bacteria: Pseudomonas Fluorescens A506 (006438); Pseudomonas Fluorescens 1629rs (006439); Pseudomonas Syringae 742rs (006411) Products, Regulating Pestidices. Ingredient Fact Sheets, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1378286
Reference: Wilson, M.; Lindow, S. E, 1993, Interactions Between The Biological Control Agent Pseudomonas Fluorescens A506 And Erwinia Amylovora In Pear Blossoms, *Phytopathology* 83: 117-1, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1378287
Reference: Porteous, L.A. et al, 2002, Multiple Enzyme Restriction Fragment Length Polymorphism Analysis For High Resolution Distinction Of Pseudomonas (Sensu Stricto) 16S rRNA Genes, *Journal Of Microbiological Methods* 51: 337-348, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1378289
Reference: Sands, D. C. et al, 1970, Taxonomy Of Phytopathogenic Pseudomonads, *The Journal Of Bacteriology* 101: 9-23, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1393396
Reference: Pajaro, M.C.and I. Albesa, 1990, [production Of Pyoverdina By Pseudomonas Fluorescens In Human Blood At 4 Degrees C: Association With Proteins And The Cytotoxic Effect Of The Pigment], *Review Argentina Microbiology* 22: 24-30, Data Numbering Code: M2.7.2

PMRA Document Number: 1393397
Reference: Pajaro, M.C. et al, 1995, [pseudomonas Fluorescens: Production Of Pyoverdine In Human Blood At 4 Degrees C And Cytotoxic Effect Of The Pigment], *Review Latinoam Microbiology* 37: 1-6, Data Numbering Code: M2.7.2

PMRA Document Number: 1393398
Reference: Scott, J. et al, 1988, A Fatal Transfusion Reaction Associated With Blood Contaminated With Pseudomonas Fluorescens, *Vox Sang* 54: 201-204, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393399
Reference: Stenhouse, M. A. And L.V. Milner, 1992, A Survey Of Cold-growing Gram-negative Organisms Isolated From The Skin Of Prospective Blood Donors, *Transfusion Medicine* 2: 235-237, Data Numbering Code: M2.7.2

PMRA Document Number: 1393400
Reference: Moenne-loccoz, Y. et al, 1998, An Investigation Of The Impact Of Biocontrol Pseudomonas Fluorescens F113 On The Growth Of Sugarbeet And The Performance Of Subsequent Clover-rhizobium Symbiosis, *Applied Soil Ecology* 7: 22, Data Numbering Code: M2.7.2

PMRA Document Number: 1393401
Reference: Hirano, S.S. And C.D. Upper, 2000, Bacteria In The Leaf Ecosystem With Emphasis On Pseudomonas Syringae-a Pathogen, Ice Nucleus, And Epiphyte, *Microbiology And Molecular Biology Reviews* 64: 624-653, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393402
Reference: Burgos, F. et al, 1996, Bacterial Colonization As A Potential Source Of Nosocomial Respiratory Infections In Two Types Of Spirometer, *European Respiratory Journal* 9: 2612-2617, Data Numbering Code: M2.7.2

PMRA Document Number: 1393403
Reference: Palavecino, E. et al, 2004, Bacterial Contamination Of Blood Products, *Opinion In Hematology* 10: 434-439, Data Numbering Code: M2.7.2

PMRA Document Number: 1393404
Reference: Gibb, A. P, 2000, Bacterial Contamination Of Donated Blood, *Reviews In Medical Microbiology* 11: 179-187, Data Numbering Code: M2.7.2

PMRA Document Number: 1393405
Reference: Selvaraju, S.B. et al, 2005, Biocidal Activity Of Formaldehyde And Nonformaldehyde Biocides Toward Mycobacterium Immunogenum And Pseudomonas Fluorescens In Pure And Mixed Suspensions In Synthetic Metalworking Fluid And Saline, *Applied Environmental Microbiology*, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393406
Reference: Murray, A. et al, 1987, Blood Transfusion-associated Pseudomonas Fluorescens Septicaemia: Is This An Increasing Problem?, Murray Ae, Bartzokas Ca, Shepherd Aj & Roberts Fm (1987). Blood Transfusion-associated Pseudomonas Fluorescens Septicaemia: Is This An Increasing Problem? *Journal of Hospital Infections* 9: 243-248, Data Numbering Code: M2.7.2

PMRA Document Number: 1393407
Reference: Wilkinson, F. H. And K.G. Kerr, 1998, Bottled Water As A Source Of Multi-resistant Stenotrophomonas And Pseudomonas Species For Neutropenic Patients, *European Journal of Cancer Care* (England) 7: 12-1, Data Numbering Code: M2.7.2

PMRA Document Number: 1393408
Reference: Index Fungorum Partnership, 2004, CABI Bioscience Databases. Classification Based On 9th Edition Of *The Dictionary Of The Fungi*, Data Numbering Code: M2.7.2

PMRA Document Number: 1393409
Reference: Zdorovenko, G. et al, 1999, Characterization Of The Lipopolysaccharide From A Pseudomonas Fluorescens (biovar I) Strain, *Mikrobiologiya* 68: 330-339, Data Numbering Code: M2.7.2

PMRA Document Number: 1393410
Reference: Hessen, M. T. et al, 1987, Clinical Efficacy Of Ciprofloxacin Therapy For Gram-negative Bacillary Osteomyelitis, *American Journal of Medicine* 82: 262-265, Data Numbering Code: M2.7.2

PMRA Document Number: 1393411
Reference: Nelson, K.E. et al, 2002, Complete Genome Sequence And Comparative Analysis Of The Metabolically Versatile Pseudomonas Putida KT2440, *Environmental Microbiology* 4: 799-808, Data Numbering Code: M2.7.2

PMRA Document Number: 1393412
Reference: Paulsen, I. T.et al, 2005, Complete Genome Sequence Of The Plant Commensal Pseudomonas Fluorescens PF-5, *Biotechnology* 23: 873-878, Data Numbering Code: M2.7.2

PMRA Document Number: 1393413
Reference: Namnyak, S. et al, 1999, Contaminated Lithium Heparin Bottles As A Source Of Pseudobacteraemia Due To Pseudomonas Fluorescens, *Journal Of Hospital Infection* (1999) 41: 23-28, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393414
Reference: Van Heel, David A. et al, 2001, Crohn's Disease: Genetic Susceptibility, Bacteria, And Innate Immunity, *The Lancet* 357: 1902-1904, Data Numbering Code: M2.7.2

PMRA Document Number: 1393415
Reference: 2007, Data Numbering Code M2.7.2 Biological Properties Of MPCA, Data Numbering Code: M2.7.2

PMRA Document Number: 1393416
Reference: Zucker, et al, 2005, Determination Of The Inflammatory Potential Of Bioaerosols By Using Human Whole Blood Cytokine Response, *Indoor And Built Environment* 14: 255-258, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393418
Reference: Lowder, M. et al, 2000, Effect Of Starvation And The Viable-but-nonculturable State On Green Fluorescent Protein (GFP) Fluorescence In GFP-tagged Pseudomonas Fluorescens A506, *Applied And Environmental Microbiology*, Data Numbering Code: M2.7.2

PMRA Document Number: 1393419
Reference: Gagniere, H. And P. Di Martino, 2004, Effects Of Antibiotics On Pseudomonas Aeruginosa NK125502 And Pseudomonas Fluorescens MF0 Biofilm Formation On Immobilized Fibronectin, *Journal of Chemotherapy* 16: 244-247, Data Numbering Code: M2.7.2

PMRA Document Number: 1393420
Reference: Johansen, C. et al, 1997, Enzymatic Removal And Disinfection Of Bacterial Biofilms, *Applied Environmental Microbiology* 63: 3724-3728, Data Numbering Code: M2.7.2

PMRA Document Number: 1393421
Reference: Mcdonald, C. et al, 2001, Evaluation Of Donor Arm Disinfection Techniques, *Vox Sanguinis* 80: 135-141, Data Numbering Code: M2.7.2

PMRA Document Number: 1393422
Reference: Morris, C.E. And L.L. Kinkel, 2002, Fifty Years Of Phylosphere Microbiology: Significant Contributions To Research In Related Fields, *Phyllosphere Microbiology*. APS Press, St. Paul, Minn : 365-375, Data Numbering Code: M2.7.2

PMRA Document Number: 1393423
Reference: Gottlieb, T, 1993, Hazards Of Bacterial Contamination Of Blood Products, *Anaesthesia And Intensive Care* 21: 20-23, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393424
Reference: De Lima Pimenta, A. et al, 2003, In Vitro Identification Of Two Adherence Factors Required For In Vivo Virulence Of Pseudomonas Fluorescens, *Microbes Infection* 5: 1177-1187, Data Numbering Code: M2.7.2

PMRA Document Number: 1393425
Reference: Edwards, S. G. et al, 1998, Interactions Between Pseudomonas Fluorescens Biocontrol Agents And Glomus Mosseae, An Arbuscular Mycorrhizal Fungus, Within The Rhizosphere, *Fems Microbiology Letters* 166: 297-303, Data Numbering Code: M2.7.2

PMRA Document Number: 1393426
Reference: Pusey, P.l, 2001, Interrelationship Of Temperature, Flower Development And Biological Control Of Fire Blight. IX International Workshop On Fire Blight, *Acta Horticolae* 590: 247-251, Data Numbering Code: M2.7.2

PMRA Document Number: 1393427
Reference: Carpenter, E.M. And D. Dicks, 1982, Isolation Of Pseudomonas Fluorescens After Suprapubic Catheterisation, Journal Of Clinical Pathology; *Journal Of Clinical Pathology* 35: 581, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393428
Reference: Bernstein, D.I. et al, 1995, Machine Operator's Lung. A Hypersensitivity Pneumonitis Disorder Associated With Exposure To Metalworking Fluid Aerosols, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393429
Reference: Johnson, K. B. And V.O. Stockwell, 1998, Management Of Fire Blight: A Case Study In Microbial Ecology, *Annual Review Of Phytopathology* 36: 227-248, Data Numbering Code: M2.7.2

PMRA Document Number: 1393430
Reference: Sigsgaard, T. et al, 2005, Microbial Cell Wall Agents As An Occupational Hazard, *Toxicology And Applied Pharmacology* 207: 310-319, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393431
Reference: Lindow, S. E. And Brandl, M. T, 2003, Microbiology Of The Phyllosphere, *Applied And Environmental Microbiology* 69: 1875-1883, Data Numbering Code: M2.7.2

PMRA Document Number: 1393432
Reference: Bodilis, J. And S. Barray, 2006, Molecular Evolution Of The Major Outer-membrane Protein Gene (OPRF) Of Pseudomonas, *Microbiology* 152: 1075-1088. Data Numbering Code: M2.7.2

PMRA Document Number: 1393433
Reference: Iglewski, B. H. And D. Kabat, 1975, NAD-dependent Inhibition Of Protein Synthesis By Pseudomonas Aeruginosa Toxin, *Proceedings Of The National Academy Of Sciences Of The United States Of America* 72: 2284-2288, Data Numbering Code: M2.7.2

PMRA Document Number: 1393434
Reference: Rais-bahrami, K. et al, 1990, Neonatal Pseudomonas Sepsis: Even Early Diagnosis Is Too Late, *Clinical Pediatrics* 29: 444, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393435
Reference: Sarubbi, Jr, F.A. et al, 1978, Nosocomial Meningitis And Bacteremia Due To Contaminated Amphotericin B, *JAMA : The Journal Of The American Medical Association* 239: 416-418, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393436
Reference: Bodilis, J. et al, 2006, Oprf Polymorphism As A Marker Of Ecological Niche In Pseudomonas, Bodilis J, Hedde M, Orange N & Barray S (2006). Oprf Polymorphism As A Marker Of Ecological Niche In Pseudomonas. *Environmental Microbiology* 8: 1544-1551, Data Numbering Code: M2.7.2

PMRA Document Number: 1393437
Reference: Dubey, et al, 1988, Osteomyelitis Secondary To Trauma Or Infected Contiguous Soft Tissue, *Pediatric Infectious Diseases Journal* 7: 26-34, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393438
Reference: Hsueh, P.R. et al, 1998, Outbreak Of Pseudomonas Fluorescens Bacteremia Among Oncology Patients, *Journal Of Clinical Microbiology* 36: 2914-2917, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393439
Reference: Bodilis, J. et al, 2004, Phylogenetic Relationships Between Environmental And Clinical Isolates Of Pseudomonas Fluorescens And Related Species Deduced From 16S rRNA Gene And OPRF Protein Sequences, Data Numbering Code: M2.7.2

PMRA Document Number: 1393441
Reference: Lindemann, J. et al, 1982, Plants As Sources Of Airborne Bacteria, Including Ice Nucleation-active Bacteria, *Applied And Environmental Microbiology* 44: 1059-1063, Data Numbering Code: M2.7.2

PMRA Document Number: 1393442
Reference: Puckett, A. et al, 1992, Post Transfusion Septicaemia 1980-1989: Importance Of Donor Arm Cleansing, *Journal of Clinical Pathology* 45: 155-157, Data Numbering Code: M2.7.2

PMRA Document Number: 1393443
Reference: Zavizion, B. et al, 2003, Prevention Of Yersinia Enterocolitica, Pseudomonas Fluorescens, And Pseudomonas Putida Outgrowth In Deliberately Inoculated Blood By A Novel Pathogen-reduction Process, *Transfusion* 43:, Data Numbering Code: M2.7.2

PMRA Document Number: 1393444
Reference: Ma, Q. et al, 2003, Protein Secretion Systems Of Pseudomonas Aeruginosa And P. Fluorescens, *Biochimica Et Biophysica Acta (BBA) - Biomembranes* 1611: 223-233, Data Numbering Code: M2.7.2

PMRA Document Number: 1393445
Reference: Todar, K, 2004, Pseudomonas And Related Bacteria, *Textbook Of Bacteriology*, Data Numbering Code: M2.7.2

PMRA Document Number: 1393446
Reference: Centers For Disease Control And Prevention, 2005, Pseudomonas Bloodstream Infections Associated With A Heparin/saline Flush --- Missouri, New York, Texas, And Michigan, 2004--2005, *Centers For Disease Control And Prevention Morbidity And Mortality Weekly Report* 54: 269-272. Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393447
Reference: Khabbaz, R.F. et al, 1984, Pseudomonas Fluorescens Bacteremia From Blood Transfusion, *The American Journal Of Medicine* 76: 62-68, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393448
Reference: Wei, B. et al, 2002, Pseudomonas Fluorescens Encodes The Crohn's Disease-associated I2 Sequence And T-cell Superantigen, *Infection Immunology* 70: 6567-6575, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393449
Reference: Pappas, G. et al, 2006, Pseudomonas Fluorescens Infections In Clinical Practice, Scandinavian *Journal Of Infectious Diseases* 38: 68-70, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393450
Reference: Gibaud, M. et al, 1984, Pseudomonas Fluorescens Septicemia Following Transfusion Of Contaminated Blood, *Presse Medicale* (Paris, France : 1983) 13: 2583-2584, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393451
Reference: Manfredi, R. et al, 2000, Pseudomonas Organisms Other Than Pseudomonas Aeruginosa As Emerging Bacterial Pathogens In Patients With Human Immunodeficiency Virus Infection, *Infectious Diseases In Clinical Practice* 9: 79-87, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393453
Reference: Thompson, I. et al, 1993, Quantitative And Qualitative Seasonal Changes In The Microbial Community From The Phyllosphere Of Sugar Beet (Beta Vulgaris), *Plant And Soil* 150: 177-191, Data Numbering Code: M2.7.2, M9.0

PMRA Document Number: 1393454
Reference: Fishwick, David, et al, 2005, Respiratory Symptoms, Immunology And Organism Identification In Contaminated Metalworking Fluid Workers. What You See Is Not What You Get, *Occupational Medicine* 55: 238-241, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393455
Reference: Palavecino, E. And Yomtovian, R, 2003, Risk And Prevention Of Transfusion-related Sepsis, *Current Opinion In Hematology* 10: 434-439, Data Numbering Code: M2.7.2

PMRA Document Number: 1393456
Reference: Mercier, J. And S.E. Lindow, 2000, Role Of Leaf Surface Sugars In Colonization Of Plants By Bacterial Epiphytes, *Applied And Environmental Microbiology* 66: 369-374, Data Numbering Code: M2.7.2

PMRA Document Number: 1393457
Reference: Rodriguez . et al, 1989, Severe Intrahepatic Cholestasis In Sepsis Caused By Pseudomonas Fluorescens, *Revista Clinica Espanola* 185: 106-107, Data Numbering Code: M2.7.2

PMRA Document Number: 1393458
Reference: Veremeichenko, S. N. et al, 2005, Structural Characteristics And Biological Properties Of Pseudomonas Fluorescens Lipopolysaccharides, *Applied Biochemistry And Microbiology* 41: 365-371, Data Numbering Code: M2.7.2

PMRA Document Number: 1393459
Reference: Beattie, G. A. And S.E. Lindow, 1994, Survival, Growth, And Localization Of Epiphytic Fitness Mutants Of Pseudomonas Syringae On Leaves, *Applied And Environmental Microbiology* 60: 3790-3798, Data Numbering Code: M2.7.2

PMRA Document Number: 1393461
Reference: Garrity, G. M. et al, 2004, Taxonomic Outline Of The Prokaroytes, *Bergeys Manual Of Systematic Bacteriology*. Second Edition. Data Numbering Code: M2.7.2

PMRA Document Number: 1393462
Reference: Pusey, P.l. And E.A. Curry, 2004, Temperature And Pomaceous Flower Age Related To Colonization By Erwinia Amylovora And Antagonists, *Pathology* 94: 901-911, Data Numbering Code: M2.7.2

PMRA Document Number: 1393463
Reference: Lindow, S. E. And T.V. Suslow, 2003, Temporal Dynamics Of The Biocontrol Agent Pseudomonas Fluorescens Strain A 506 In Flowers In Inoculated Pear Trees, *Phytopathology* 93: 727-737, Data Numbering Code: M2.7.2

PMRA Document Number: 1393464
Reference: Todar, K, 2006, *Textbook Of Bacteriology*, Data Numbering Code: M2.7.2

PMRA Document Number: 1393465
Reference: Berg, Gabriele et al, 2005, The Rhizosphere As A Reservoir For Opportunistic Human Pathogenic Bacteria, *Environmental Microbiology* 7: 1673-1685, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393466
Reference: Jacobs, J.L. et al, 2005, The Role Of Pigmentation, Ultraviolet Radiation Tolerance, And Leaf Colonization Strategies In The Epiphytic Survival Of Phyllosphere Bacteria, *Microbial Ecology* 49: 104-113, Data Numbering Code: M2.7.2

PMRA Document Number: 1393467
Reference: Beattie, G.a. And S.e. Lindow, 1995, The Secret Life Of Foliar Bacterial Pathogens On Leaves, *Annual Review Of Phytopathology* 33: 145-172, Data Numbering Code: M2.7.2

PMRA Document Number: 1393468
Reference: Stockwell, V.O. And J.E. Loper, 2005, The Sigma Factor RPOS Is Required For Stress Tolerance And Environmental Fitness Of Pseudomonas Fluorescens PF-5, *Microbiology* (reading, England) 151: 3001-3009, Data Numbering Code: M2.7.2

PMRA Document Number: 1393469
Reference: Essex, R.W. et al, 2004, Three Cases Of Post-traumatic Endophthalmitis Caused By Unusual Bacteria, *Clinical & Experimental Ophthalmology* 32: 445-447, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393470
Reference: Tree Of Life Web Project, 1997, *Tree Of Life Web Project* (1997). Version 01 January 1997 (temporary). http://tolweb.org/life_on_earth/1/1997.01.01, Accessed: Oct 10, 2006, Data Numbering Code: M2.7.2

PMRA Document Number: 1393471
Reference: Preston, G. M. et al, 2001, Type III Secretion In Plant Growth-promoting Pseudomonas Fluorescens SBW25, *Molecular Microbiology* 41: 999-1014, Data Numbering Code: M2.7.2

PMRA Document Number: 1393472
Reference: Sundin, G. W. And J.l. Jacobs, 1999, Ultraviolet Radiation (uvr) Sensitivity Analysis And Uvr Survival Strategies Of A Bacterial Community From The Phyllosphere Of Field-grown Peanut (arachis Hypogeae L.), *Microbial Ecology* 38: 27-38, Data Numbering Code: M2.7.2

PMRA Document Number: 1393473
Reference: Centers For Disease Control And Prevention (CDC), 2006, Update: Delayed Onset Pseudomonas Fluorescens Bloodstream Infections After Exposure To Contaminated Heparin Flush--michigan And South Dakota, *Morbidity And Mortality Weekly Report* 55: 961-963, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393474
Reference: Stockwell, V. et al, 2005, Effect Of The Iron Chelate Feeddha On Control Of Fire Blight By Pseudomonas Fluorescens A 506, *Phytopathology* 95, Data Numbering Code: M2.7.2

PMRA Document Number: 1393475
Reference: Brenner, D. J.; Krieg, N. R.; Staley, J. T.; Garrity, G. M, 2005, Bergeys Manual Of Systematic Bacteriology: Order Pseudomonadales, *Bergeys Manual Of Systematic Bacteriology*. Vol 2c. Springer, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1393476
Reference: Moore, Edward R.B. et al, 2004, Pseudomonas: Nonmedical, In *The Prokaryotes* (web Version), Data Numbering Code: M2.7.2, M9.0

2.0 IMPACT ON HUMAN AND ANIMAL HEALTH

PMRA Document Number: 1393487
Reference: 2007, Summary And Information On Data Numbering Code M4 - Human Health And Safety Testing, Data Numbering Code: M4.0, M4.1, M4.2, M4.2.1, M4.2.2, M4.2.3, M4.3, M4.3.1, M4.3.2, M4.3.3, M4.4, M4.5, M4.5.1, M4.5.2, M4.6, M4.7, M4.8

PMRA Document Number: 1393488
Reference: 1985, Acute Oral Toxicity Of AGS 3001.2 In Sprague-dawley Rats, Data Numbering Code: M4.2.2

PMRA Document Number: 1393489
Reference: 1990, Acute Oral Toxicity/pathogenicity Of Frostban A (LX1201-01) In The Rat, Data Numbering Code: M4.2.2

PMRA Document Number: 1393490
Reference: 1985, Acute Inhalation Toxicity Study Of AGS 3001.2 In Sprague-dawley Rats, Data Numbering Code: M4.2.3, M4.4

PMRA Document Number: 1393491
Reference: 1990, Acute Intraperitonal Toxicity Test Frostban Microbial Pest Control Agent, Data Numbering Code: M4.3.2, M4.3.3

PMRA Document Number: 1393492
Reference: 1985, Primary Dermal Irritation Study Of AGS 3001.2 In New Zealand White Rabbits, Data Numbering Code: M4.4, M4.5.2
PMRA Document Number: 1393493
Reference: 1999, Data Submitted In Support Of Registration Of Frostban B (list), Data Numbering Code: M4.9

PMRA Document Number: 1393494
Reference: 1999, Data Submitted In Support Of Registration Of Frostban: NPRIS Search Results, Data Numbering Code: M4.9

PMRA Document Number: 1393495
Reference: 1985, Primary Eye Irritation Study Of AGS 3001.2 In New Zealand White Rabbits, Data Numbering Code: M4.9

3.0 IMPACT ON THE ENVIRONMENT

PMRA Document Number: 1378282
Reference: Yamamoto, S. et al, 2000, Phylogeny Of The Genus Pseudomonas: Intrageneric Structure Reconstructed From The Nucleotide Sequences Of Gyrb And Rpod Genes, *Microbiology* (reading, England) 146: 2385-2394, Data Numbering Code: M2.7.1

PMRA Document Number: 1378278
Reference: 1992, US EPA Pesticide Fact Sheet: Frostban A, Data Numbering Code: M2.12, M2.14

PMRA Document Number: 1378360
Reference: Wilson, M. And S.E. Lindow, 1993, Interactions Between The Biological Control Agent Pseudomonas Fluorescens A506 And Erwinia Amylovora In Pear Blossoms, *Phytopathology* 83:1, 1993. pp 117-123, Data Numbering Code: M2.7.1, M2.7.2

PMRA Document Number: 1378280
Reference: 2007, Origin And Derivation And Identification Of MPCA, Data Numbering Code: M2.7.1, M8.0, M9.0

PMRA Document Number: 1393398
Reference: Scott, J. et al, 1988, A Fatal Transfusion Reaction Associated With Blood Contaminated With Pseudomonas Fluorescens, *Vox Sang* 54: 201-204, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393401
Reference: Hirano, S.S. And C.D. Upper, 2000, Bacteria In The Leaf Ecosystem With Emphasis On Pseudomonas Syringae-a Pathogen, Ice Nucleus, And Epiphyte, Microb*iology And Molecular Biology Reviews* 64: 624-653, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393405
Reference: Selvaraju, S.B. et al, 2005, Biocidal Activity Of Formaldehyde And Nonformaldehyde Biocides Toward Mycobacterium Immunogenum And Pseudomonas Fluorescens In Pure And Mixed Suspensions In Synthetic Metalworking Fluid And Saline, *Applied Environmental Microbiology*, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393413
Reference: Namnyak, S. et al, 1999, Contaminated Lithium Heparin Bottles As A Source Of Pseudobacteraemia Due To Pseudomonas Fluorescens, *Journal Of Hospital Infection* (1999) 41: 23-28, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393416
Reference: Zucker, et al, 2005, Determination Of The Inflammatory Potential Of Bioaerosols By Using Human Whole Blood Cytokine Response, *Indoor And Built Environment* 14: 255-258, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393423
Reference: Gottlieb, T, 1993, Hazards Of Bacterial Contamination Of Blood Products, *Anaesthesia And Intensive Care* 21: 20-23, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393427
Reference: Carpenter, E.M. And D. Dicks, 1982, Isolation Of Pseudomonas Fluorescens After Suprapubic Catheterisation, Journal Of Clinical Pathology; *Journal Of Clinical Pathology* 35: 581, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393428
Reference: Bernstein, D.I. et al, 1995, Machine Operator's Lung. A Hypersensitivity Pneumonitis Disorder Associated With Exposure To Metalworking Fluid Aerosols, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393430
Reference: Sigsgaard, T. et al, 2005, Microbial Cell Wall Agents As An Occupational Hazard, *Toxicology And Applied Pharmacology* 207: 310-319, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393434
Reference: Rais-bahrami, K. et al, 1990, Neonatal Pseudomonas Sepsis: Even Early Diagnosis Is Too Late, *Clinical Pediatrics* 29: 444, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393435
Reference: Sarubbi, Jr, F.A. et al, 1978, Nosocomial Meningitis And Bacteremia Due To Contaminated Amphotericin B, *JAMA : The Journal Of The American Medical Association* 239: 416-418, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393437
Reference: Dubey, et al, 1988, Osteomyelitis Secondary To Trauma Or Infected Contiguous Soft Tissue, *Pediatric Infectious Diseases Journal* 7: 26-34, Data Numbering Code: M2.7.2, M8.0, M9.0
PMRA Document Number: 1393438

Reference: Hsueh, P.R. et al, 1998, Outbreak Of Pseudomonas Fluorescens Bacteremia Among Oncology Patients, *Journal Of Clinical Microbiology* 36: 2914-2917, Data Numbering Code: M2.7.2, M8.0, M9.0
PMRA Document Number: 1393446

Reference: Centers For Disease Control And Prevention, 2005, Pseudomonas Bloodstream Infections Associated With A Heparin/saline Flush --- Missouri, New York, Texas, And Michigan, 2004-2005, *Centers For Disease Control And Prevention Morbidity And Mortality Weekly Report* 54: 269-272. Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393447
Reference: Khabbaz, R.F. et al, 1984, Pseudomonas Fluorescens Bacteremia From Blood Transfusion, *The American Journal Of Medicine* 76: 62-68, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393448
Reference: Wei, B. et al, 2002, Pseudomonas Fluorescens Encodes The Crohn's Disease-associated I2 Sequence And T-cell Superantigen, *Infection Immunology* 70: 6567-6575, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393449
Reference: Pappas, G. et al, 2006, Pseudomonas Fluorescens Infections In Clinical Practice, Scandinavian *Journal Of Infectious Diseases* 38: 68-70, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393450
Reference: Gibaud, M. et al, 1984, Pseudomonas Fluorescens Septicemia Following Transfusion Of Contaminated Blood, *Presse Medicale* (Paris, France : 1983) 13: 2583-2584, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393451
Reference: Manfredi, R. et al, 2000, Pseudomonas Organisms Other Than Pseudomonas Aeruginosa As Emerging Bacterial Pathogens In Patients With Human Immunodeficiency Virus Infection, *Infectious Diseases In Clinical Practice* 9: 79-87, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393453
Reference: Thompson, I. et al, 1993, Quantitative And Qualitative Seasonal Changes In The Microbial Community From The Phyllosphere Of Sugar Beet (Beta Vulgaris), *Plant And Soil* 150: 177-191, Data Numbering Code: M2.7.2, M9.0

PMRA Document Number: 1393454
Reference: Fishwick, David, et al, 2005, Respiratory Symptoms, Immunology And Organism Identification In Contaminated Metalworking Fluid Workers. What You See Is Not What You Get, *Occupational Medicine* 55: 238-241, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393465
Reference: Berg, Gabriele et al, 2005, The Rhizosphere As A Reservoir For Opportunistic Human Pathogenic Bacteria, *Environmental Microbiology* 7: 1673-1685, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393469
Reference: Essex, R.W. et al, 2004, Three Cases Of Post-traumatic Endophthalmitis Caused By Unusual Bacteria, *Clinical & Experimental Ophthalmology* 32: 445-447, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393473
Reference: Centers For Disease Control And Prevention (CDC), 2006, Update: Delayed Onset Pseudomonas Fluorescens Bloodstream Infections After Exposure To Contaminated Heparin Flush--michigan And South Dakota, *Morbidity And Mortality Weekly Report* 55: 961-963, Data Numbering Code: M2.7.2, M8.0, M9.0

PMRA Document Number: 1393476
Reference: Moore, Edward R.B. et al, 2004, Pseudomonas: Nonmedical, In *The Prokaryotes* (web Version), Data Numbering Code: M2.7.2, M9.0

PMRA Document Number: 1393496
Reference: 2007, Summary And Rationales For Data Numbering Codes M5-M9 Exposure Assessment Etc, Data Numbering Code: M5.0, M7.0, M8.0, M8.1, M8.2, M8.2.1, M8.2.2, M8.3, M8.4, M8.5, M9.0, M9.1, M9.2, M9.2.1, M9.2.2, M9.3, M9.4, M9.4.1, M9.4.2, M9.5, M9.5.1, M9.5.2, M9.6, M9.7, M9.8, M9.8.1, M9.8.2, M9.9

PMRA Document Number: 1393497
Reference: Shawkey, M.S. et al, 2005, Microbial Diversity Of Wild Bird Feathers Revealed Through Culture-based And Culture-independent Techniques, *Microbial Ecology* 50: 40-47, Data Numbering Code: M9.0, M9.2

PMRA Document Number: 1393498
Reference: Jackson, M. K. And S.N. Phillips, 1996, Necrotizing Hepatitis In Pet Birds Associated With Pseudomonas Fluorescens, *Avian Diseases* 40: 473-476, Data Numbering Code: M9.0, M9.2

PMRA Document Number: 1393499
Reference: 1991, Acute Contact Toxicity On Honey Bees In Georgia, Data Numbering Code: M9.5.1

PMRA Document Number: 1393500
Reference: Pusey, P. L, 2002, Biological Control Agents For Fire Blight Of Apple Compared Under Conditions Limiting Natural Dispersal, *Plant Disease* 86: 639-644, Data Numbering Code: M9.5.1

PMRA Document Number: 1393501
Reference: 1990, Pathogenicity To Plants, Data Numbering Code: M9.8.1

4.0 VALUE

PMRA Document Number: 1378313
Reference: Capsule Summary: Fire blight of apple and pear. DACO 10.1

PMRA Document Number: 1378316
Reference: 2007. Biocontrol of Fire Blight of Pear and Apple with Blightban A506 and P. agglomerans C9-1. DACO 10.2.2

PMRA Document Number: 1378319
Reference: 2004. Control of fire blight by *Pseudomonas fluorescens* A506 introduced into unopened pear flowers. DACO 10.2.2

PMRA Document Number: 1378320
Reference: 2004.Control of Fireblight in Apple (Golden Delicious) in Oregon. DACO 10.2.2

PMRA Document Number: 1378321
Reference: 2004. Control of Fireblight in Apple (Golden Delicious) in Oregon. DACO 10.2.2

PMRA Document Number: 1378322
Reference: 2002. Control of Fireblight in Apple (Golden Delicious) in Oregon. DACO 10.2.2

PMRA Document Number: 1378323
Reference: 2005. Control of Fireblight in Apple (Idared, Empire) in New York. Cornell University. DACO 10.2.2

PMRA Document Number: 1378324
Reference: 2005. Control of Fireblight in Apple (Jonathan, Golden Delicious) in Michigan. Michigan State University. DACO 10.2.2

PMRA Document Number: 1378325
Reference: 2003. Control of Fireblight in Apple (Rome Beauty) in Oregon. Oregon State University. DACO 10.2.2
PMRA Document Number: 1378327
Reference: 2002. Control of Fireblight in Apple in Virginia. Virginia Tech Ag. Research and Extension Center. DACO 10.2.2

PMRA Document Number: 1378328
Reference: 2004. Control of Fireblight in Pear (Bartlett) in Oregon. Oregon State University. DACO 10.2.2

PMRA Document Number: 1378329
Reference: 1999. Control of Fireblight in Pears (Bartlett) in Oregon.Oregon State University. DACO 10.2.2

PMRA Document Number: 1378330
Reference: 2002. Control of Fireblight in Pears (Bartlett) in Oregon I. Oregon State University. DACO 10.2.2

PMRA Document Number: 1378331
Reference: 2002. Control of Fireblight in Pears (Bartlett) in Oregon II. Oregon State University. DACO 10.2.2

PMRA Document Number: 1378332
Reference: 1998. Efficacy of Blightband A506 for control of pear fire blight in 1998. AAFC Pacific Agri-Food Research Centre. DACO 10.2.2

PMRA Document Number: 1378333
Reference: 2001. Final report on the activity of Blightban A506 (Pseudomonas fluorescens) for the control of fire blight on apple. Ramsdell Chemical Testing, Inc. DACO 10.2.2

PMRA Document Number: 1378336
Reference: 2005 Results of fire blight control and flower colonization and fruit russet evaluations on pear and apple treated with different Blightban formulations. University of California Berkeley. DACO 10.2.2

PMRA Document Number: 1378337
Reference: 1998. Secondary colonization of pear blossoms by two bacterial antagonists of the fire blight pathogen. DACO 10.2.2

PMRA Document Number: 13783382
Reference: 2005. The use of Blightban to reduce the incidence of fire blight in apple. AAFC Southern Crop Protection and Food Research Centre. DACO 10.2.2

PMRA Document Number: 1378339
Reference: Value summary. Pest Management Centre, AAFC. 2007. DACO 10.0, 10.1, 10.2, 10.2.1, 10.2.2, 10.3, 10.3.1, 10.3.2, 10.3.2.1, 10.3.2.2, 10.4, 10.4.1, 10.4.2, 10.4.3, 10.4.4

PMRA Document Number: 1388997
Reference: 2002. Biological Control Agents for Fire Blight of Apple Compared Under Conditions Limiting Natural Dispersal. DACO 10.2.2, 9.5.1

PMRA Document Number: 1388998
Reference: 1990. Pathogenicity to Plants. Frost Technology Corporation. DACO10.3.1, 9.8.1

PMRA Document Number : 1378326
Reference : Control of Fireblight in Apple (Rome Beauty) in Oregon. Oregon State University. F&N Tests Vol 58:PF025. DACO 10.2.2

PMRA Document Number: 1378335
1995. Reduction of Fire Blight, Frost and Russet Using Frostban B (A506). Proceedings of the 69th Annual Western Orchard Pest & Disease Management Conference. 11-13 January 1995. Portland, OR. pp. 101-102. DACO 10.2.2

PMRA Document Number: 1378340
2002. Stockwell, V.O., et al, Biological control of fire blight: Understanding interactions among introduced and indigenous microbial communities. *Phyllosphere Micorbiology*, DACO 10.1, 10.2, 10.2.2, 10.3.2, 10.3.2.1, 10.3.2.2, 10.4, 10.4.1, 10.4.2, 10.4.3, 10.4.4

B. ADDITIONAL INFORMATION CONSIDERED

i) Published Information

1.0 METHODS OF ANALYSIS

PMRA Document Number: 1658624
Reference: Nuclo, R.L, Johnson, K.B, Stockwell, V.O, Sugar, D, 1998, Secondary Colonization Of Pear Blossoms By Two Bacterial Antagonists Of The Fire Blight Pathogen, P. 661-668, *Plant Disease*, June 1998, Vol. 82 No. 6 - D-1998-0402-01r, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659565
Reference: Skorska C et al, 2005, Exposure To Airborne Microorganisms, Dust And Endotoxin During Processing Of Valerian Roots On Farms, Data Numbering Code: M2.0, M4.0, M8.0, M9.0

PMRA Document Number: 1659566
Reference: Saygili H. et al, Tomato Pith Necrosis Disease Caused By Pseudomonas Species In Turkey, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659567
Reference: Hildebrand P.D, 1989, Surfactant-like Characteristics And Identity Of Bacteria Associated With Broccoli Head Rot In Atlantic Canada, *Canadian Journal Of Plant Pathology*, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659568
Reference: Meadow Anderson L, Stockwell V. O. et al, 2004, Biological Control An Extracellular Protease Of Pseudomonas Fluorescens Inactivates Antibiotics Of Pantoea Agglomerans, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659569
Reference: Cui X. And Harling R, 2005, Biological Control Evaluation Of Bacterial Antagonists For Biological Control Of Broccoli Head Rot Caused By Pseudomonas Fluorescens, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659574
Reference: Compant S. et al, Minireview Use Of Plant Growth-promoting Bacteria For Biocontrol Of Plant Diseases: Principles, Mechanisms Of Action, And Future Prospects, Vol. 71, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659576
Reference: Das Kumar B. et al, 2005, Antagonistic Activity Of Cellular Components Of Pseudomonas Species Against Aeromonas Hydrophila, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659582
Reference: Etebarian H-r. et al, 2005, Biological Control Of Apple Blue Mold With Pseudomonas Fluorescens, Vol. 51 Pages 591-598, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659588
Reference: Haas D. And Defago G, 2005, Biological Control Of Soil-borne Pathogens By Fluorescent Pseudomonads, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659591
Reference: Kamilova F. et al, 2006, Effects Of The Tomato Pathogen Fusarium Oxysporum F.sp. Radicis-lycopersici And Of The Bioccontrol Bacterium Pseudomonas Fluorescens Wcs365 *On The Composition Of Organic Acids And Sugars In Tomato Root Exudate*, Vol. 19, No. 10, 2006/1121-1126, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659596
Reference: Karthikeyan V. And Gnanamanickam S.S, 2007, Biological Control Of Setaria Blast (magnaporthe Grisea) With Bacterial Strains, *Crop Protection* 27 (2008) 263-267, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659601
Reference: Khan M.R. et al, 2005, Biological Control Of Fusarium Seedling Blight Disease Of Wheat And Barley, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659602
Reference: Malandraki I. et al, 2007, Thermal Inactivation Of Compost Suppressiveness Implicates Possible Biological Factors In Disease Management, Biological Control 44 (2008) 180-187, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659604
Reference: Martinez-granero F. et al, 2006, Rhizosphere Selection Of Highly Motile Phenotypic Variants Of Pseudomonas Fluorescens With Enhanced Competitive Colonization Ability, Vol. 72, No. 5 Pages 3429-3434, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659650
Reference: Schmidt C.S. et al, 2003, Influence Of Soil Temperature And Matric Potential On Sugar Beet Seedling Colonization And Suppression Of Pythium Damping-off By The Antagonistic Bacteria Pseudomonas Fluorescens And Bacillus Subtilis, Vol. 94, No. 4 2004 Pages 351-363, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659709
Reference: Slininger P.J, 2007, Biological Control Of Post-harvest Late Blight Of Potatoes, *Biocontrol Science And Technology*, 2007; 17(5/6): 647-663, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660093
Reference: Someya N. et al, 2007, Biocontrol Science And Technology Combined Application Of Pseudomonas Fluorescens Strain Lrb3w1 With A Low Dosage Of Benomyl For Control Of Cabbage Yellows Caused By Fusarium Oxysporum F.sp. Conglutinans, *Biocontrol Science And Technology*, 2007; 17 (1): 21-31, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660098
Reference: Srivastava A.k, 2001, Induced Resistance And Control Of Charcoal Rot In Cicer Arietinum (chickpea) By Pseudomonas Fluorescens, *Canadian Journal of Botany* 79: 787-795 (2001), Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660110
Reference: Stockwell V.O. et al, 1998, Establishment Of Bacterial Antagonists Of Erwinia Amylovora On Pear And Apple Blossoms As Influenced By Inoculum Preparation, Vol. 88, No. 6 1998 Pages 506-513, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660119
Reference: Temple T.N. et al, 2004, Bioavailability Of Iron To Pseudomonas Fluorescens Strain A506 On Flowers Of Pear And Apple, Vol. 94, No. 12, 2004 Pages 1286-1294, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660148
Reference: Velusamy P, 2006, Biological Control Of Rice Bacterial Blight By Plant-associated Bacteria Producing 2,4-diacetylphloroglucinol, *Canadian Journal of Microbiology* Volume 52, 2006 Pages 57-65, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660168
Reference: Wang C. et al, 2004, Colonization And Persistence Of A Plant Growth-promoting Bacterium Pseudomonas Fluorescens Strain Cs85, On Roots Of Cotton Seedlings, *Canadian Journal of Microbiology* Volume 50, 2004 Pages 475-481, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660173
Reference: Weller D. M, The Nature And Application Of Biocontrol Microbes III: Pseudomonas Spp. Pseudomonas Biocontrol Agents Of Soilborne Pathogens: Looking Back Over 30 Years, Volume 97, No. 2, 2007 Pages 250-256, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669436
Reference: Biocontrol Of Sclerotinia Wilt Of Sunflower By Pseudomonas Fluorescens And Pseudomonas Putida Strains, Data Numbering Code: M2.0, M9.0

PMRA Document Number: 1669687
Reference: Biocontrol Of Broomrape (orobanche Crenata Forsk. And Orobanche Foetida Poir.) By Pseudomonas Fluorescens Isolate Bf7-9 From *The Faba Bean Rhizosphere*, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669703
Reference: Inhibition Of Armillaria By Bacteria Isolated From Soils Of The Boreal Mixedwood Forest Of Ontario, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669704
Reference: Inefectivity And Ecology Of Pseudomonas Spp. From Natural Epizootics In The Rice Leaf Folder, Cnaphalocrocis Medinalis (lepidoptera: Pyralidae) In India, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669708
Reference: First Report Of Tomato (lycopersicon Esculentum) Pith Necrosis Caused By Pseudomonas Fluorescens And P. *Corrugata In The Kingdom Of Saudi Arabia*, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669712
Reference: Application And Evaluation Of Pseudomonas Strains For Biocontrol Of Wheat Seedling Blight, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669713
Reference: First Report Of Head Rot Of Brassica Oleracea Convar. Botrytis Var. Italica Caused By Pseudomonas Fluorescens In Southern Italy, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669717
Reference: Characterization Of A Pseudomonas Fluorescens Strain From Tomato Rhizosphere And Its Use For Integrated Management Of Tomato Damping-off, Data Numbering Code: M2.0, M9.0

PMRA Document Number: 1669733
Reference: Pseudomonas-induced Defence Molecules In Rice Plants Against Leaffolder (cnaphalocrocis Medinalis) Pest, Data Numbering Code: M2.0, M9.0

2.0 IMPACT ON HUMAN AND ANIMAL HEALTH

PMRA Document Number: 1659565
Reference: Skorska C et al, 2005, Exposure To Airborne Microorganisms, Dust And Endotoxin During Processing Of Valerian Roots On Farms, Data Numbering Code: M2.0, M4.0, M8.0, M9.0

3.0 IMPACT ON THE ENVIRONMENT

PMRA Document Number: 1658624
Reference: Nuclo, R.L, Johnson, K.B, Stockwell, V.O, Sugar, D, 1998, Secondary Colonization Of Pear Blossoms By Two Bacterial Antagonists Of The Fire Blight Pathogen, P. 661-668, *Plant Disease* Vol. 82 No. 6 - D-1998-0402-01r, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659565
Reference: Skorska C et al, 2005, Exposure To Airborne Microorganisms, Dust And Endotoxin During Processing Of Valerian Roots On Farms, Data Numbering Code: M2.0, M4.0, M8.0, M9.0
PMRA Document Number: 1659566

Reference: Saygili H. et al, Tomato Pith Necrosis Disease Caused By Pseudomonas Species In Turkey, Data Numbering Code: M2.0, M8.0, M9.0
PMRA Document Number: 1659567
Reference: Hildebrand P.D, 1989, Canadian Journal Of Plant Pathology Surfactant-like Characteristics And Identity Of Bacteria Associated With Broccoli Head Rot In Atlantic Canada, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659568
Reference: Meadow Anderson L, Stockwell V. O. et al, 2004, Biological Control An Extracellular Protease Of Pseudomonas Fluorescens Inactivates Antibiotics Of Pantoea Agglomerans, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659569
Reference: Cui X. And Harling R, 2005, Biological Control Evaluation Of Bacterial Antagonists For Biological Control Of Broccoli Head Rot Caused By Pseudomonas Fluorescens, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659574
Reference: Compant S. et al, Minireview Use Of Plant Growth-promoting Bacteria For Biocontrol Of Plant Diseases: *Principles, Mechanisms Of Action, And Future Prospects*, Vol. 71, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659576
Reference: Das Kumar B. et al, 2005, Antagonistic Activity Of Cellular Components Of Pseudomonas Species Against Aeromonas Hydrophila, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659582
Reference: Etebarian H-r. et al, 2005, Biological Control Of Apple Blue Mold With Pseudomonas Fluorescens, Vol. 51 Pages 591-598, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659588
Reference: Haas D. And Defago G, 2005, Biological Control Of Soil-borne Pathogens By Fluorescent Pseudomonads, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659591
Reference: Kamilova F. et al, 2006, Effects Of The Tomato Pathogen Fusarium Oxysporum F.sp. Radicis-lycopersici And Of The Bioccontrol Bacterium Pseudomonas Fluorescens Wcs365 *On The Composition Of Organic Acids And Sugars In Tomato Root Exudate*, Vol. 19, No. 10, 2006/1121-1126, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659596
Reference: Karthikeyan V. And Gnanamanickam S.S, 2007, Biological Control Of Setaria Blast (magnaporthe Grisea) With Bacterial Strains, *Crop Protection* 27 (2008) 263-267, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659601
Reference: Khan M.R. et al, 2005, Biological Control Of Fusarium Seedling Blight Disease Of Wheat And Barley, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659602
Reference: Malandraki I. et al, 2007, Thermal Inactivation Of Compost Suppressiveness Implicates Possible Biological Factors In Disease Management, *Biological Control* 44 (2008) 180-187, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659604
Reference: Martinez-granero F. et al, 2006, Rhizosphere Selection Of Highly Motile Phenotypic Variants Of Pseudomonas Fluorescens With Enhanced Competitive Colonization Ability, Vol. 72, No. 5 Pages 3429-3434, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659650
Reference: Schmidt C.S. et al, 2003, Influence Of Soil Temperature And Matric Potential On Sugar Beet Seedling Colonization And Suppression Of Pythium Damping-off By The Antagonistic Bacteria Pseudomonas Fluorescens And Bacillus Subtilis, Vol. 94, No. 4 2004 Pages 351-363, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1659709
Reference: Slininger P.J, 2007, Biological Control Of Post-harvest Late Blight Of Potatoes, *Biocontrol Science And Technology*, 2007; 17(5/6): 647-663, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660093
Reference: Someya N. et al, 2007, Biocontrol Science And Technology Combined Application Of Pseudomonas Fluorescens Strain Lrb3w1 With A Low Dosage Of Benomyl For Control Of Cabbage Yellows Caused By Fusarium Oxysporum F.sp. Conglutinans, *Biocontrol Science And Technology*, 2007; 17 (1): 21-31, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660098
Reference: Srivastava A.k, 2001, Induced Resistance And Control Of Charcoal Rot In Cicer Arietinum (chickpea) By Pseudomonas Fluorescens, *Canadian Journal of Botany* 79: 787-795 (2001), Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660110
Reference: Stockwell V.O. et al, 1998, Establishment Of Bacterial Antagonists Of Erwinia Amylovora On Pear And Apple Blossoms As Influenced By Inoculum Preparation, Vol. 88, No. 6 1998 Pages 506-513, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660119
Reference: Temple T.N. et al, 2004, Bioavailability Of Iron To Pseudomonas Fluorescens Strain A506 On Flowers Of Pear And Apple, Vol. 94, No. 12, 2004 Pages 1286-1294, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660148
Reference: Velusamy P, 2006, Biological Control Of Rice Bacterial Blight By Plant-associated Bacteria Producing 2,4-diacetylphloroglucinol, *Canadian Journal of Microbiology* Volume 52, 2006 Pages 57-65, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660168
Reference: Wang C. et al, 2004, Colonization And Persistence Of A Plant Growth-promoting Bacterium Pseudomonas Fluorescens Strain Cs85, On Roots Of Cotton Seedlings, Canadian Journal of Microbiology Volume 50, 2004 Pages 475-481, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1660173
Reference: Weller D. M, The Nature And Application Of Biocontrol Microbes III: Pseudomonas Spp. Pseudomonas Biocontrol Agents Of Soilborne Pathogens: Looking Back Over 30 Years, Volume 97, No. 2, 2007 Pages 250-256, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669436
Reference: Biocontrol Of Sclerotinia Wilt Of Sunflower By Pseudomonas Fluorescens And Pseudomonas Putida Strains, Data Numbering Code: M2.0, M9.0

PMRA Document Number: 1669687
Reference: Biocontrol Of Broomrape (orobanche Crenata Forsk. And Orobanche Foetida Poir.) By Pseudomonas Fluorescens Isolate Bf7-9 From The Faba Bean Rhizosphere, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669703
Reference: Inhibition Of Armillaria By Bacteria Isolated From Soils Of The Boreal Mixedwood Forest Of Ontario, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669704
Reference: Inefectivity And Ecology Of Pseudomonas Spp. From Natural Epizootics In The Rice Leaf Folder, Cnaphalocrocis Medinalis (lepidoptera: Pyralidae) In India, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669708
Reference: First Report Of Tomato (lycopersicon Esculentum) Pith Necrosis Caused By Pseudomonas Fluorescens And P. Corrugata In The Kingdom Of Saudi Arabia, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669712
Reference: Application And Evaluation Of Pseudomonas Strains For Biocontrol Of Wheat Seedling Blight, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669713
Reference: First Report Of Head Rot Of Brassica Oleracea Convar. Botrytis Var. Italica Caused By Pseudomonas Fluorescens In Southern Italy, Data Numbering Code: M2.0, M8.0, M9.0

PMRA Document Number: 1669717
Reference: Characterization Of A Pseudomonas Fluorescens Strain From Tomato Rhizosphere And Its Use For Integrated Management Of Tomato Damping-off, Data Numbering Code: M2.0, M9.0

PMRA Document Number: 1669733
Reference: Pseudomonas-induced Defence Molecules In Rice Plants Against Leaffolder (cnaphalocrocis Medinalis) Pest, Data Numbering Code: M2.0, M9.0

PMRA Document Number: 1681386
Reference: 2002, Fluorescent Pseudomonad Population Sizes Baited From Soils Under Pure Birch, Pure Douglas-fir, And Mixed Forest Stands And Their Antagonism Toward Armillaria Ostoyae In Vitro, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681394
Reference: 2000, Natural Incidence Of Endophytic Bacteria In Pea Cultivars Under Field Conditions, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681401
Reference: 2004, Plant-associated Pseudomonas Populations: Molecular Biology, DNA Dynamics, And Gene Transfer, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681407
Reference: 1990, A Survey Of The Diseases Of Marine Turtles In Northern Australia. I. Farmed Turtles, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681410
Reference: 2008, Secondary Metabolite Production Facilitates Establishment Of Rhizobacteria By Reducing Both Protozoan Predation And The Competitive Effects Of Indigenous Bacteria, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681412
Reference: 2007, Pseudomonas Fluorescens Hyk0210-sk09 Offers Speciesspecific Biological Control Of Winter Algal Blooms Caused By Freshwater Diatom Stephanodiscus Hantzschii, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681415
Reference: 2007, Detection Of The Causative Agent Of Furunculusis, Aeromonas Salmonicida In Salmonids Of The KRKA River, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681424
Reference: 2007, Alga-lytic Activity Of Pseudomonas Fluorescens Against The Red Tide Causing Marine Alga Heterosigma Akashiwo (raphidophyceae), Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681429
Reference: 2005, Epiphytic Microorganisms On Strawberry Plants (fragaria Ananassa Cv. Elsanta): Identification Of Bacterial Isolates And Analysis Of Their Interaction With Leaf Surfaces, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681436
Reference: 2003, Minireview - Microbiology Of The Phyllosphere, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681439
Reference: 2007, Interactions Between Plants And Beneficial Pseudomonas Spp.: Exploiting Bacterial Traits For Crop Protection, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681442
Reference: 1964, Description And Treatment Of A Pseudomonas Infection In White Catfish, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681444
Reference: 2006, Assessment Of The Environmental Fate Of The Biological Control Agent Of Fire Blight, Pseudomonas Fluorescens Eps62e, On Apple By Culture And Real-time PCR Methods, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1681448
Reference: 2002, Horizontal And Vertical Movement Of Pseudomonas Fluorescens Toward Exudate Of Macrophomina Phaseolina In Soil: Influence Of Motility And Soil Properties, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684580
Reference: 1985, Enumeration And Identification Of Heterotrophic Bacteria In Groundwater And In A Mountain Stream, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684600
Reference: 1996, Douglas-fir Root-associated Microorganisms With Inhibitory Activity Towards Fungal Plant Pathogens And Human Bacterial Pathogens, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684608
Reference: 1996, Characterization Of Microbial Communities In Deep Groundwater From Granitic Rock, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684613
Reference: Pseudomonas Fluorescens In Association With Bodies Of The Ectomycorrhizal Mushroom Cantharellus Cilbarius, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684634
Reference: In Vitro Antagonism Of The Probiont Pseudomonas Fluorescens Strain AH2 Against Aeromonas Salmonicida Does Not Confer Protection Of Salmon Against Furunculosis, Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684659
Reference: 1966, A Proteolytic Pseudomonad From Skin Lesions Of Rainbow Trout (salmo Gairdnerii), Data Numbering Code: M8.0, M9.0

PMRA Document Number: 1684669
Reference: Establishment And Survival On Apple And Pear Leaves Of Four Biological Control Agents Including Pantoea Agglomerans P10c And Pseudomonas Fluorescens A506, Data Numbering Code: 8.0, M9.0

PMRA Document Number: 1719808
Reference: Zhao, B.G. et al, 2006, Effects Of Bacteria Associated With Pine Wood Nematode (Bursaphelenchus Xylophilus) On Development And Egg Production Of The Nematode. Department Of Forest Entomology And Pathology, Nanjing Forestry University, Nanjing, China. Journal of Phytopathology 155, 26–30 (2007), *Journal of Phytopathology* 155, 26–30 (2007), Data Numbering Code: M8.0, M9.0